THE JOURNAL OF GAS LIGHTING
WATER SUPPLY & SANITARY IMPROVEMENT

VOL. LX. No. 1542.] LONDON, NOVEMBER 29, 1892. [44TH YEAR. PRICE 6d.

GAS AND WATER PIPES

1¼ to 12 IN. BORE.

THOMAS ALLAN & SONS,

Bon Lea Foundry,

SOUTH STOCKTON-ON-TEES.

ALSO MANUFACTURERS OF

SANITARY & RAIN-WATER PIPES, HOT WATER PIPES, STABLE FITTINGS, RANGES, STOVES, And GENERAL CASTINGS.

GLASGOW OFFICE: 24, GEORGE SQUARE.

Telegrams:

"BONLEA, STOCKTON-ON-TEES."

"SPRINGBANK, GLASGOW."

— ESTABLISHED 1830. —

PARKER & LESTER,

Manufacturers & Contractors.

THE ONLY MAKERS OF

PATENT ANTIMONY PAINT,

Parker's Imperial Black Varnish,

Oxide Paints, Oils, and General Stores for Gas and Water Works.

WORKS:

ORMSIDE STREET, OLD KENT ROAD, LONDON.

WOLSTON'S

TORBAY PAINTS

Special Quotations to Gas Companies.

DARTMOUTH, DEVON.

Lanemark Coal Co.,

LIMITED.

LANEMARK CANNEL

AND GAS COALS.

Quotations and Analysis on application to

LANEMARK COLLIERY,

NEW CUMNOCK, N.B.

Shipping Ports: All the principal Scotch Ports.

GASHOLDERS

C. & W. WALKER

Have completed a four-lift Holder nearly 200 feet high, of about 8 MILLION cubic feet, at the Beckton Gas-Works, London.

PURIFIERS;

PURIFYING MACHINES;

CO_2 AND TAR-EXTRACTING WASHERS; SCRUBBERS;

SULPHATE & SULPHUR PLANT.

PATENT SELF-SEALING RETORT MOUTHPIECES;

LIFTING APPARATUS; CENTRE AND FOUR-WAY VALVES;

SOLE MANUFACTURERS OF WECK'S PATENT CENTRE-VALVE;

PATENT TAR PLANT; CONDENSERS;

SLIDE VALVES; TAR BURNERS; &C., &C.

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ADDRESSES:

MIDLAND IRON-WORKS, DONNINGTON, NEAR NEWPORT, SHROPSHIRE;

10, Finsbury Square, London.

"FORTRESS DONNINGTON," "FORTRESS LONDON."—Telegraphic.

SAWER AND PURVES,

LATE

FLETCHER AND MURPHY,

GARRATT STREET WORKS, OLDHAM ROAD, MANCHESTER,

Manufacturers of

IMPROVED CONSUMERS' WET GAS-METERS

IN CAST-IRON CASES,

THE UNVARYING WATER-LINE GAS-METER,

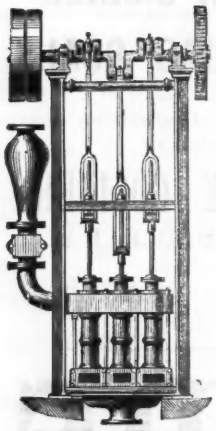
AND

IMPROVED DRY GAS-METERS.

SPECIALITY: PATENT CASH PREPAYMENT METERS.

STEAM & HAND PUMPS FOR GAS-WORKS,

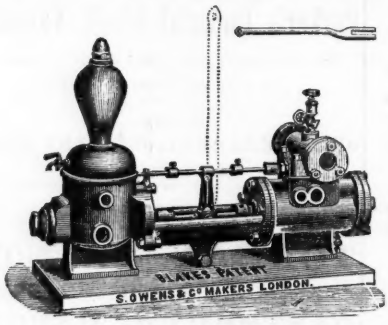
FOR PUMPING TAR, WATER, AND LIQUOR.



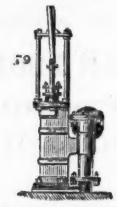
Treble-Barrel Pumps in Frame.

Syphon Pump.

Double-Barrel Force-Pump in Frame.



BLAKE'S
PATENT
STEAM PUMPS.
20,000 IN USE.



Improved Double Action Pump.

Cast-Iron Hand-Pump.

Wrought-Iron Portable Pump.

S. OWENS & CO., Hydraulic, Gas, & General Engineers, WHITEFRIARS ST., LONDON, E.C.

SOLE MANUFACTURERS OF

MANN & OWENS' PATENT SCREW & CAM, also FULL-WAY RACK & PINION GAS-VALVES.

S. O. and Co.'s New Catalogue of Gas Apparatus and General Machinery can be had on application.

NEWTON, CHAMBERS, & CO., LIMITED,

THORNCLIFFE IRON-WORKS, near SHEFFIELD,

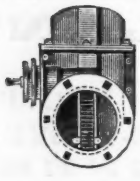
MANUFACTURERS OF

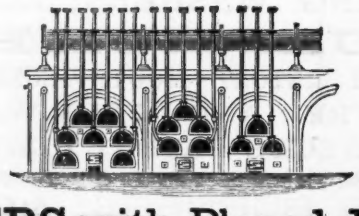
SLIDE VALVES,
WITH RACK & PINION
OR
Internal or External
SCREWS, of all Sizes.
GASHOLDERS,
AND
Gasholder Tanks.

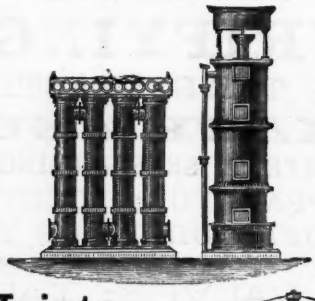
CAST-IRON RETORTS,
RETORT-BED FITTINGS,
And Retort-House Appliances
of every description.
Iron Roofs, Columns, Girders, Floor Plates and Tools, &c.

WROUGHT AND CAST IRON
CONDENSERS,
SCRUBBERS, & WASHERS,
TAR AND LIQUOR PUMPS, &c.

PATENT
CENTRE VALVES
for working Purifiers.
Also Bye-Pass & Stop Valves.







PURIFIERS with Planed Joints,
HAND and HYDRAULIC LIFTING GEAR, CAST-IRON MAINS and SPECIALS,
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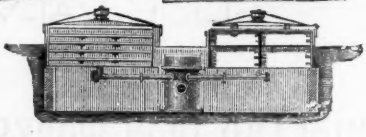
CAST AND WROUGHT IRON TANKS AND CISTERNS.



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Pig Iron (*Special Quality*) for ENGINE CYLINDERS, &c.

GAS COAL FAMOUS FOR ITS UNRIVALLED EXCELLENCE.

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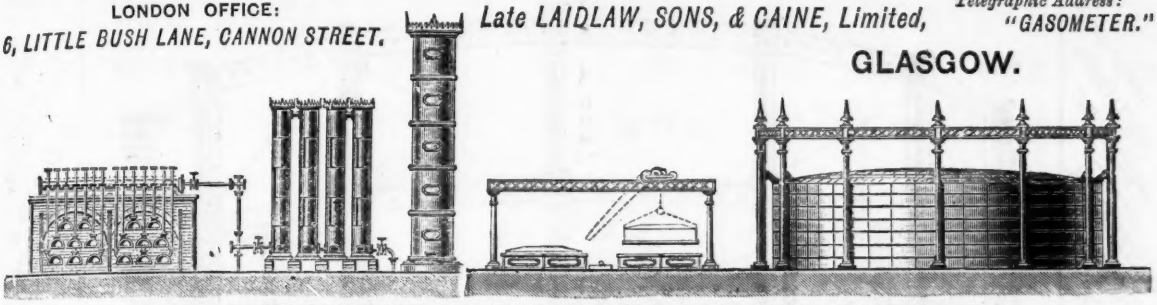
6, LITTLE BUSH LANE, CANNON STREET.

Late LAIDLAW, SONS, & CAINE, Limited,
GLASGOW.

Telegraphic Address:
"GASOMETER."



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RETORT-BENCH FITTINGS; SIEMENS'S REGENERATIVE AND ORDINARY FURNACES;
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HYDRAULIC AND HAND-POWER LIFTING APPARATUS;
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STATION METERS; GOVERNORS; SCREW AND RACK VALVES;
FOUR-WAY COCKS AND HYDRAULIC VALVES;
CAST-IRON GAS, WATER, & STEAM PIPES & CONNECTIONS; WROUGHT-IRON TUBES & FITTINGS;
IRON ROOFING, MARKET BUILDINGS, BRIDGES, GIRDERS, STEAM BOILERS;
PROMENADE PIERS AND LOADING WHARVES.

MANUFACTURERS OF OIL PLANT OF EVERY DESCRIPTION.

HENDERSON'S Patent Retorts, Condensers, Stills, Cast and Wrought Iron Tanks, Ammonia Stills, Wrought-Iron Gas-Mains, &c., &c.

DESCRIPTIVE SPECIFICATIONS AND ESTIMATES ON APPLICATION.

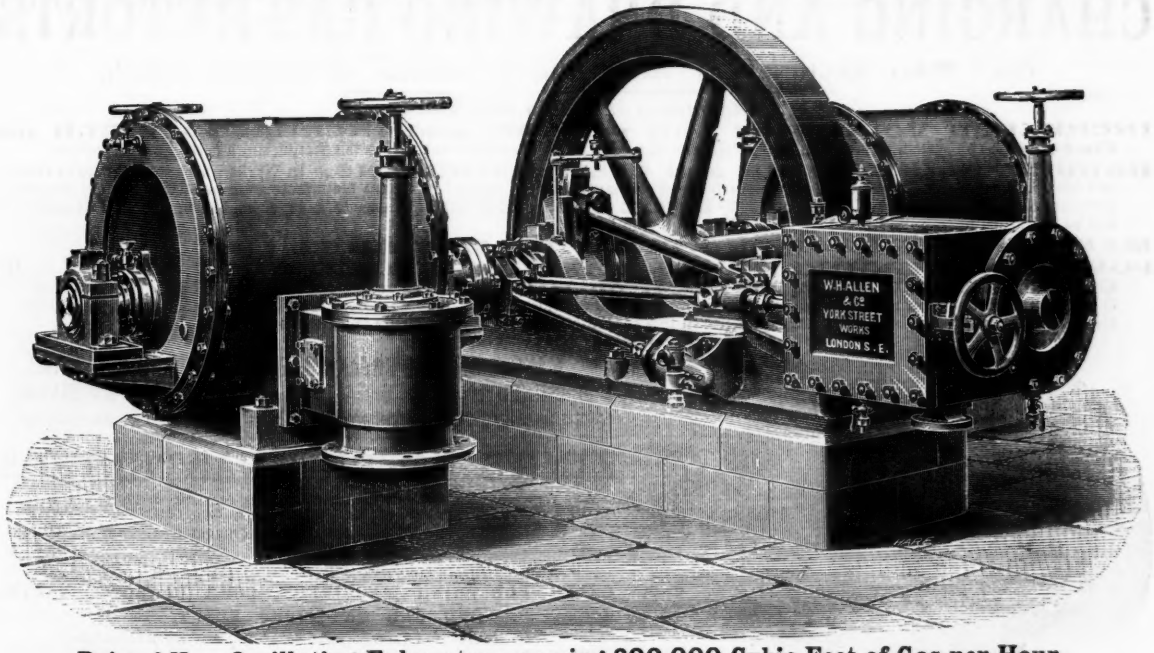
W. H. ALLEN & CO.,

York Street Works, LAMBETH, LONDON, S.E.,

MAKERS OF THE MOST IMPROVED FORM OF

GAS EXHAUSTING MACHINERY.

BEALE'S PATENT—ALLEN'S COMBINED SYSTEM.

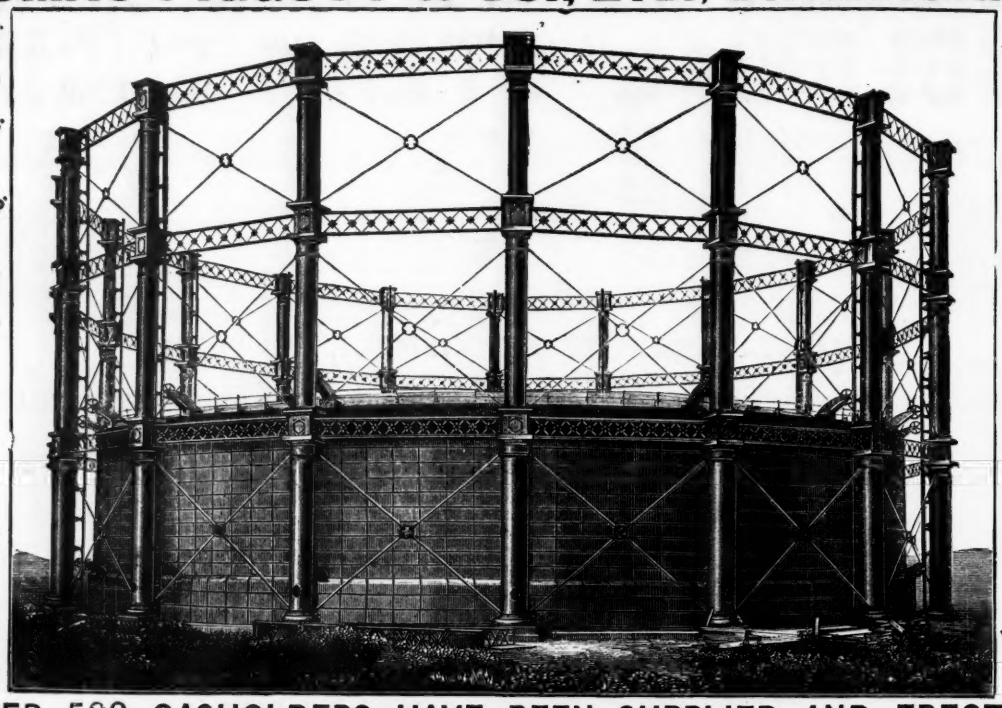


Pair of Non-Oscillating Exhausters, passing 200,000 Cubic Feet of Gas per Hour.

THOMAS PIGGOTT & CO., LTD., BIRMINGHAM.

LONDON OFFICE: ST. THOMAS APOSTLE, E.C.

GAS PLANTS, BOILERS, ENGINES, PUMPS, ROOFS RETORT. FITTINGS, ETC.



TELEGRAPHIC ADDRESS: ATLAS, BIRMINGHAM.

WELDED & RIVETED FOUL PIPES, MAINS, RETORT. LIDS, WROT & CAST TANKS, PURIFIERS.

OVER 500 GASHOLDERS HAVE BEEN SUPPLIED AND ERECTED,

INCLUDING THOSE SUPPLIED TO THE FOLLOWING GAS COMPANIES AND CORPORATIONS:

BATH.	BOLTON.	BRISTOL.	CHELTENHAM.	LEAMINGTON.	PRESTON.	SHEFFIELD.
BELFAST.	BOMBAY.	BRISBANE.	HARTLEPOOL.	LIVERPOOL.	READING.	STOCKHOLM.
BECKTON.	BRADFORD.	CARDIFF.	LEEDS.	NOTTINGHAM.	RIO GRANDE.	SYDNEY.
BIRMINGHAM.	BRIGHTON.	COVENTRY.	LEICESTER.	OLDHAM.	SOUTH METRON.	VIENNA.

WEST'S GAS IMPROVEMENT Co., Ltd.,

Engineers, Ironfounders, & Contractors,

ALBION IRON-WORKS, MILES PLATTING, MANCHESTER,

MANUFACTURERS OF

WEST'S PATENTED MACHINERY

FOR

CHARGING AND DRAWING GAS-RETORTS

OVER **240** MACHINES AT WORK AND IN COURSE OF CONSTRUCTION.

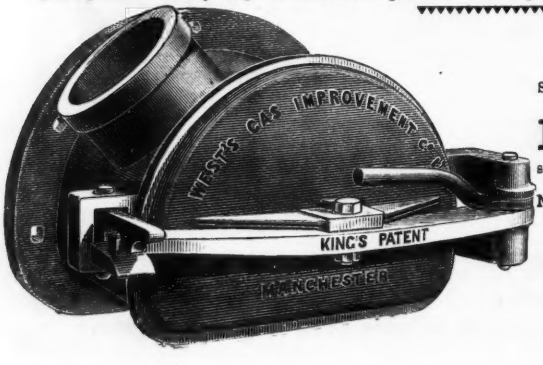
Advantages attending its use are:

INCREASED VOLUME of GAS per TON, and INCREASED YIELD per Retort.—The system of breaking and distributing the coals in an even layer in the retorts effecting more perfect carbonization.

REDUCTION in LABOUR and COST of WORKING.—In Works where this System of charging and drawing Retorts is adopted, there has been effected a substantial saving in the cost of Gas Manufacture in the Retort-House; the amount saved varying in different Gas-Works from **8 PENCE** to **15 PENCE per Ton** of coal carbonized. Full particulars will be forwarded upon application to W. G. I. Company, Limited.

MANUAL CHARGING AND DRAWING MACHINES.

POWER CHARGING AND DRAWING MACHINES, driven by COMPRESSED AIR, STEAM, or ROPE. The power machines are applicable to circular, oval, or ⌂-shaped retorts and mouthpieces, and are the most perfect, economical, efficient, and durable machines made. They are constructed on principles founded by long and extensive experience in this special branch of gas engineering and the manufacture of gas.



MAKERS OF COAL BREAKING, ELEVATING, AND CONVEYING MACHINERY, COKE BREAKING AND WASHING MACHINERY.

Sole Makers of CIRCULAR, OVAL, or ⌂-shaped MOUTHPIECES with Morton's Self-Sealing Lids, fitted with

KING'S PATENT FASTENINGS,

secure a very tight joint; and at the same time the eccentric motion given to the Lid effectually removes the Tar from the surfaces of the Joint.

N.B.—The whole of these Fittings are made of Wrought Iron. Several Thousands in use.

West's Improved Combined Regulating Liquor Seal Valve.

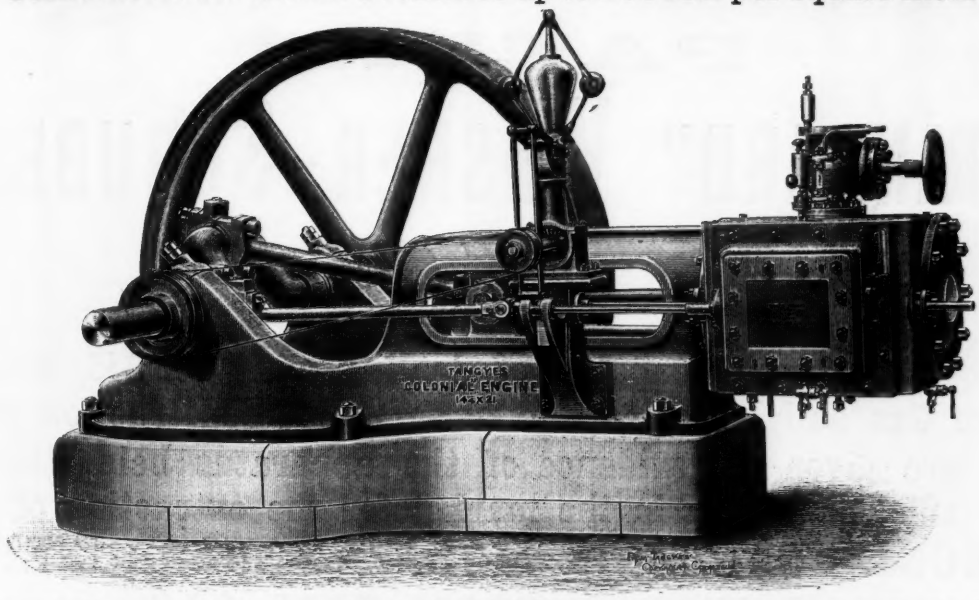
OXIDE ELEVATING MACHINERY, COKE BARROWS, VALVES, AND ALL GAS-WORKS PLANT, &c.

Illustrated Catalogue sent upon application.

Mr. JOHN WEST, M.Inst.C.E. *Managing Director.*

TANGYES'
"COLONIAL" STEAM-ENGINE

Constructed for Steam Pressures up to 100 lbs. per square inch.



Tangyes' Colonial" Steam-Engine, with the TANGYE-JOHNSON PATENT AUTOMATIC CUT-OFF GEAR. From a Photograph of the 14½ in. by 21 in. size.

PRICES QUOTED ON RECEIPT OF THE NECESSARY DATA.

TANGYES LIMITED, Cornwall Works, BIRMINGHAM.

AND LONDON, NEWCASTLE, MANCHESTER, GLASGOW, SYDNEY, MELBOURNE, JOHANNESBURG, GENOA, BILBAO, AND ROTTERDAM.

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SPENT LIMES NO LONGER WASTE PRODUCTS.

Under G. R. HISLOP'S PATENTS

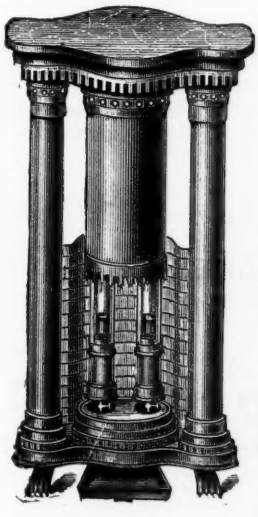
All Spent Limes are most effectually, economically, and continuously recovered, and at from one-third to one-half the cost of New Lime. The results are a surprise to all who have inspected the process, and are entirely satisfactory to all now using it. Descriptive Pamphlet and Terms from Agents as under.

—— REGENERATIVE SETTINGS OF RETORTS. ——

Hislop's Patent Producer and Patent Charging Appliances offer advantages which are unapproachable; while in every other detail his Settings are confidently recommended as being the most inexpensive and effective possible.

Illustrated Pamphlet and Terms on application to J. E. FISHER, Stourbridge, Agent for England and Wales; to C. M. HAMILTON, Portland Place, Hamilton, Agent for Scotland and Ireland; and for all other Countries to the Patentee,

Geo. R. HISLOP, Gas Engineer, PAISLEY, N.B.



THE "SYPHON" (REGISTERED TITLE.)

(CLARK'S PATENT.)

Hygienic Gas Heating-Stoves

For Use Without a Flue.

NO FLUE REQUIRED. NO SMOKE. NO SMELL.
NO DIRT OR TROUBLE. NO DANGER.

All Sulphurous Vapours are condensed inside the Stoves, and passed off as liquid into the tray beneath.

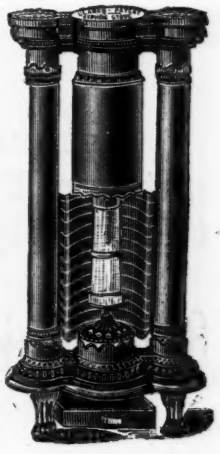
The "SYPHON" Hygienic Gas Heating-Stoves give a pure, equable, and agreeable heat, which can be graduated and sustained at the will of the user. They are so constructed that a moist or dry atmosphere is obtained at pleasure.

They are the Only Safe Stoves for use in Greenhouses, Conservatories, Bed-rooms, &c., and especially suitable for Halls, Sitting-Rooms, Offices, Shops, Schoolrooms, and Theatres.

Adopted by the principal Gas Companies throughout the Kingdom.

Illustrated Price Lists on application to

S. CLARK & CO., Patentees and Makers,
Syphon Works, Park Street, Islington, London, N.
Telegraphic Address: "Syphon Stoves, London."



KIRKHAM, HULETT, & CHANDLER,

LIMITED.

(SIDNEY HERSEY, Managing Director.) (J. CHANDLER, Engineer.)

PATENT

"STANDARD" WASHER-SCRUBBER.

456

of these Machines (capable of dealing with 436,345,000 cubic feet of Gas daily) erected and in course of construction. These facts are given as evidence of the apparatus being the most efficient of any in the market for the extraction of

AMMONIA, CARBONIC ACID, AND SULPHURETTED HYDROGEN FROM COAL GAS.

70 of the above Machines have been constructed according to the Company's latest Patent, which has also been applied to 41 original pattern Machines.

TESTIMONIALS.

The Gaslight and Coke Company,
Horseferry Road, Westminster, S.W.,
Nov. 25, 1889.

Messrs. KIRKHAM, HULETT, AND CHANDLER, LTD.,

Gentlemen,

In reply to your inquiry respecting the result of putting Wooden "Bundles" into some of the Washer-Scrubbers at our Beckton Station, I beg to say they have answered admirably for the few months they have been in; and I think them a decided success.

I am, yours truly,
(Signed) G. C. TREWBY.

NOTE.—Orders since received for four 3,500,000 cubic feet per day Machines for Beckton; and two 3,000,000 cubic feet for Kensal Green, &c., &c.

Extract from the JOURNAL OF GAS LIGHTING, &c., for Sept. 27, 1892, referring to the visit of the Members of the Eastern Counties Gas Managers' Association to the Lowestoft Gas-Works—

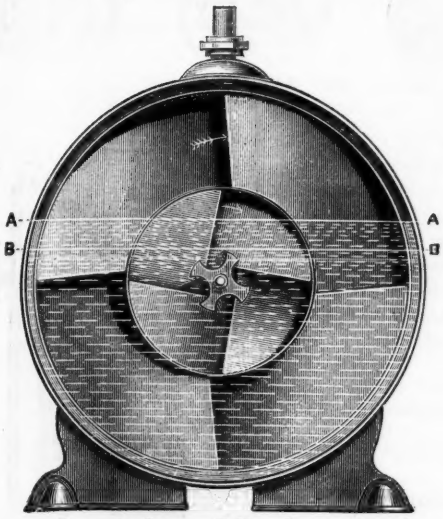
"Mr. J. Ayris has one of Messrs. Kirkham, Hulett, and Chandler's "Standard" Washer-Scrubbers in operation (capable of dealing with 500,000 cubic feet of gas per 24 hours); and of the working of this machine he spoke very highly."

Estimates furnished for cost of altering original pattern Patent "Standard" Washer-Scrubbers, or for the supply of New Machines.

ADDRESS:—

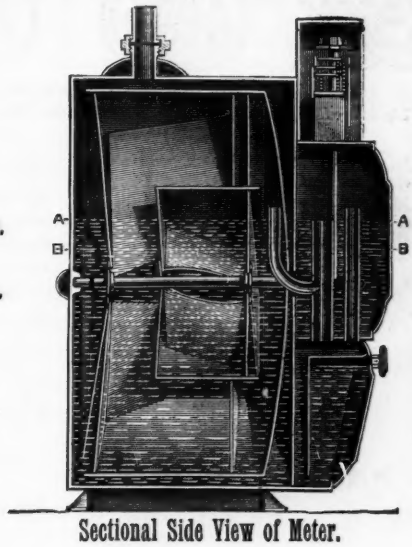
3 & 4, PALACE CHAMBERS, BRIDGE STREET, WESTMINSTER, S.W.

THE WARNER AND COWAN METER.



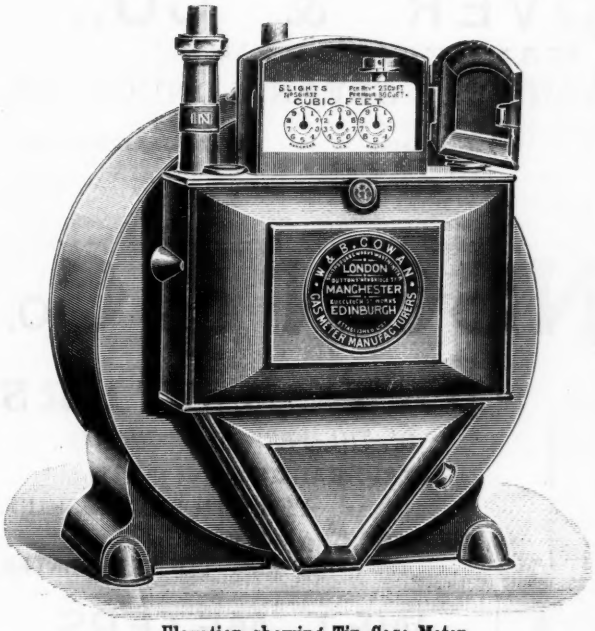
A A, High-Water Line.

B B, Low-Water Line.



Drum in Case. Hollow Cover removed.

Sectional Side View of Meter.



Elevation showing Tin Case Meter.

Elevation showing Cast-Iron Case Meter.

In its completeness as a measure, the WARNER AND COWAN drum differs from every other. Of definite capacity, irrespective of the water-line, it can neither be over nor under filled, but discharges at each revolution the same volume of gas.

It is to this also that its secondary, though important, advantage is due—viz., the long float-range which this drum permits.

The illustrations show front and side views of the drum, and also views of the complete meter—both in tin and cast-iron case.

The drum being of fixed capacity within itself, the extraneous mechanism and arrangements are of the most simple character. These include all that is necessary, but exclude all that would be superfluous.

W. & B. COWAN,

ESTABLISHED 1827

SMITH SQUARE WORKS, WESTMINSTER, **LONDON, S.W.** TELEPHONE No. 3230.

DUTTON STREET WORKS, **MANCHESTER.** TELEPHONE No. 1545.

BUCCLEUCH STREET WORKS, **EDINBURGH.** TELEPHONE No. 753.

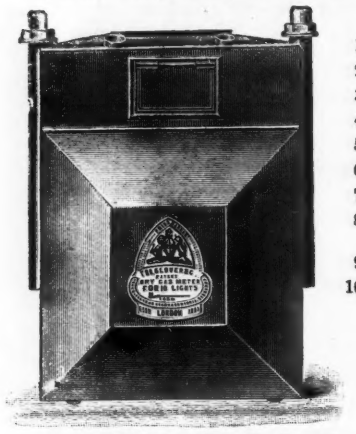
TELEGRAPHIC ADDRESSES:

"DISC LONDON." "DISC MANCHESTER." "DISC EDINBURGH."

[ESTABLISHED 1844.] **ORIGINAL MAKERS.** [ESTABLISHED 1844.]

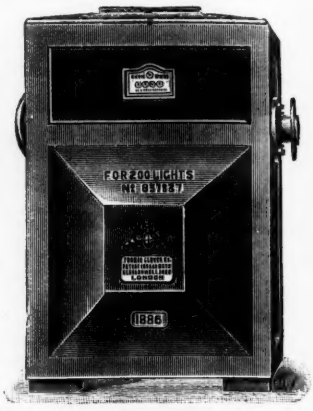
LONDON, 1851. NEW YORK, 1853. PARIS, 1855. LONDON, 1862. DUBLIN, 1865. PARIS, 1867.

THE SIX MEDALS AWARDED TO THOMAS GLOVER'S PATENT DRY GAS-METERS;
The latter being the Highest Award for Dry Gas-Meters at the Paris Exhibition, 1867. Since then we have not Exhibited FOR PRIZES.



1st.—Are a remedy for all the defects of Wet Meters.
2nd.—Are suitable for all Climates, whether hot or cold.
3rd.—Incur no loss of Gas by Evaporation.
4th.—Cannot become fixed by Frost, however severe.
5th.—Are the most accurate and unvarying measurers of Gas.
6th.—Prevent jumping or unexpected extinction of the Lights.
7th.—May be fixed either above or below the level of the Lights.
8th.—Cannot be tampered with without visibly damaging the outer case.
9th.—Will last much longer than Wet Meters.
10th.—Will not cost more than one-half for repair that Wet or Water Meters do.

Are upheld for five years without charge.



Telegraphic Address: "GOTHIC LONDON."
Telephone No. 6725.

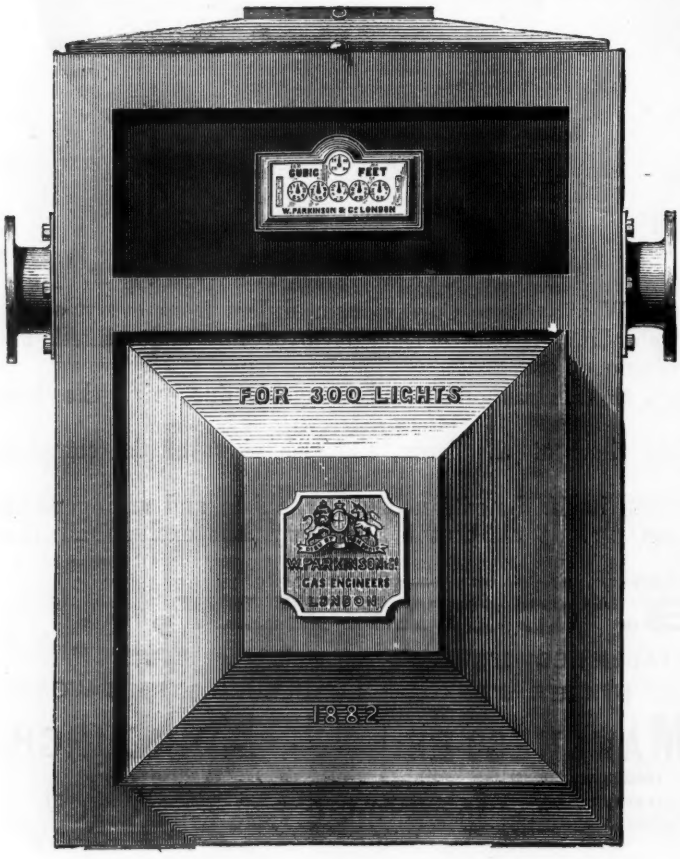
THOMAS GLOVER & CO.,

DRY GAS-METER MANUFACTURERS,

214 to 222, ST. JOHN ST., CLERKENWELL GREEN, LONDON, E.C.

BRISTOL:	BIRMINGHAM:	LEEDS:	MANCHESTER:
62, VICTORIA STREET.	3, BRIDGE ROW, DERITEND.	BOAR LANE CHAMBERS, 4, BASINGHALL STREET.	37, BLACKFRIARS STREET.
Telegraphic Address: "GOTHIC."	*Telegraphic Address*: "GOTHIC."	*Telegraphic Address*: "GOTHIC."	*Telegraphic Address*: "GOTHIC."

W. PARKINSON & Co.



MANUFACTURERS OF

DRY METERS

OF THE VERY BEST QUALITY.

The DIAPHRAGMS are of the Finest PERSIAN SHEEP SKINS.

The CASES are of the Best CHARCOAL-TINNED PLATES.

WET METERS,

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THE

JOURNAL OF GAS LIGHTING,

WATER SUPPLY, & SANITARY IMPROVEMENT.

TUESDAY, NOVEMBER 29, 1892.

The London Chamber of Arbitration.

THE inauguration of the City of London Chamber of Arbitration on Wednesday last is an event to strike the commercial world. It marks the culmination of a movement that has been going on for many years; and if the experiment succeeds, the same idea will certainly receive further embodiment and development. The objects of the founders of the Chamber are "to secure the speedy "and inexpensive settlement of disputes arising in the "course of business, and to provide facilities for disputants wishing to settle their differences without having "recourse to litigation, especially such trade disputes as "can best be dealt with by experienced men of business." The Chamber is to be open both to voluntary applicants and for the arbitration of cases referred to it from the Courts or by the Judges; and its decisions and awards will have the force and effect of a verdict in the High Court. When once the parties to a dispute have signed the form of submission, neither can subsequently retract without the sanction of the other. The scheme is the joint production of the Corporation of London and the London Chamber of Commerce; and the Chamber will be managed by a Joint Committee of these bodies. A list of arbitrators is to be compiled, consisting of gentlemen willing to serve in this capacity, and specially qualified for their office by long business experience or special trade knowledge, or both. Mr. Philbrick, Q.C., has undertaken the office of Legal Assessor; and Mr. Thomas Roderick, the Secondary of the City, will for the time being discharge the duties of Registrar. All proceedings are to be regarded as private and confidential; and no persons besides the officials and witnesses are to be allowed to be present at the hearing of disputes, except such as the disputants may agree to admit. The parties may be represented at the hearing by a solicitor or counsel, upon giving notice to the other side, or by a person in their actual or permanent employment; or, in the case of country suitors, by their London agents. The Chamber is to be open daily throughout the year.

For the origin of this experiment, we must look to the state of the Courts of Law, which have utterly failed to satisfy the need of the commercial and industrial community for just, cheap, and expeditious means of settling business disputes. It would not be fair to ascribe all the blame for the discredit into which the Courts have fallen in the estimation of business men, to the law itself, or to the judicial system of the country. The Courts are open to everybody, and all causes must be dealt with practically in the same way and by the same men at the Bar or on the Bench. The effect of this has been to enormously overload the causes which do not involve any question of persons or of public policy, but only turn upon the point of which party is liable to pay money to the other in the way of business. Such causes have been withdrawn more and more from the cognizance of the Courts, by the insertion, in written agreements, of provision for the submission of disputes to arbitration. But, by the way in which these provisions have been carried out, it has often happened that the remedy has proved worse than the disease; and nobody can yet say whether the new departure by which commercial arbitrament is proposed to be simplified, will succeed in keeping clear of the machinations of blood-sucking professionals. The very proposal to erect cheaper and, to all practical intents, better tribunals alongside the regular establishments, constitutes a challenge to the members of the legal profession which the latter will not be slow to take up. The lawyers have all the force of "use and wont" on their side. It would be against nature for a solicitor, whether acting regularly as an officer of a joint-stock company or merely consulted by a casual client, to recommend recourse to the new tribunal set up in the City. Nor could he do so, as the law stands, without incurring responsibility of a kind which he dare not take; because persons can only be compelled to appear before the duly-established Courts, and it is not for a legal adviser to countenance the relinquishment of the right of a client to the protection of the law. For a similar reason, it is not to be expected that public bodies or statutory companies will be able to dispense with the aid of the Courts until they are permitted to do so by alteration of the law.

In order to properly appreciate the movement we have been contemplating, it is necessary to consider it in connection with the demand for some means of effectively dealing with labour disputes. It will then appear, together with the latter, as an illustration of the essentially law-loving spirit of the English people. Law is the creation of the people; and as it is the glory of free Britons to "abide by the laws themselves have made," it is quite open to them to modify the aspect and working of legal affairs according as time and circumstances dictate. All the august machinery of our judicial system has been

erected, piece by piece, upon the will of the people that justice should be done in the land; and when this machinery does not work satisfactorily in a particular order of cases, it is competent for persons interested in such cases to set up, by mutual consent, any system of adjudication they may prefer. It is the working of the same spirit that operates in newly-formed communities to preserve the public peace by the expedient of a Vigilance Committee. People who love justice will have it done somehow. And in respect to labour disputes, the violent, irregular operation of brute force, whether in the guise of strike or lock-out, is repugnant to the law-abiding spirit. Surely, it may be thought, this class of disputes ought to be brought under the arbitrament of some form of tribunal which both sides can respect. Time must bring a remedy for all offences against the law, even though this law be unwritten, and as little susceptible of precise definition as the ever-present sense of what is just and fair between man and man, which keeps the community in general from being always at loggerheads. Both for what it is, and for what it represents—most of all for what it may lead to—we wish the London Chamber of Arbitration success.

The Ulverston Gas-Meter Dispute.

It is not surprising that the Ulverston gas-meter case, reported in last week's Journal, should arouse the caustic mind of Mr. Thos. D. Hall, of Montrose, to write sarcastically, as in another column, about Magistrates posing as gas-meters. The case is a highly important one; and it will be impossible for the Ulverston Local Board to let it rest as the Magistrates have left it. They may as well return all their consumers' meters into store, and discontinue the farce of taking the indices, if people are to be borne out in paying just what they think proper for the gas supplied to their houses. The facts of the case are essentially few and simple, although the hearing occupied two days, and a great deal of extraneous matter was admitted into what must by courtesy be called the evidence. It appears that a Mr. Walker, a consumer of gas supplied by the Local Board of Ulverston, ran up a bill to the amount of £9 10s. 1d. for the quarter ending last Lady Day, which he disputed, and impeached the accuracy of the meter. The instrument was accordingly tested, and found to be correct within the terms of the Act. Mr. Walker declined to recognize the testing, and tendered the sum of £4 14s. 2d. in full payment of his liability to the Local Board, who declined to accept it, and sued him for the balance. At the hearing, a quibble was raised about the absence of proof as to the accuracy of a meter index; but the issue was simply whether the *primâ facie* evidence of the meter which measured Mr. Walker's gas should be accepted by the Bench as conclusive, or whether there was anything in the circumstances to throw doubt upon the registration. In the result, the Magistrates took Mr. Walker's view, and dismissed the summons with costs against the Local Board. We venture to say that, according to the report of the proceedings, the evidence which led the Bench to decide the matter in this way was of the flimsiest kind. Of course, a consumer's meter is only *primâ facie* evidence of the amount of gas that has passed through it. Neither buyer nor seller is absolutely bound by the indications of such an appliance. But it is enacted that these shall be held to be good in the sense we have stated—that is to say, that when a meter, proved to be accurate within the limits provided by the Act, shows a certain quantity of gas to have been passed through it, the onus of disproof lies entirely upon the questioner of this record. This is just as fair for the supplier as it is for the consumer, or the other way round. In the case in point, what do we find? That the consumer had the possibility, in his lighting burners and gas-fires, of using the quantity of gas recorded against him by the meter; and so it only remained to him to show conclusively that, in point of fact, he did not burn nearly so much. Here lies the *crux* of the matter; and if we probe the difficulty to the bottom, we shall probably find, as Mr. Hall justly points out, that the consumer's two gas-fires were the source of the trouble. The Ulverston Magistrates seem to have been greatly impressed by the statement made to them in evidence that Mr. Walker's gas-fires would only burn from 15 to 20 cubic feet of gas per hour at the highest pressure at which they were likely to be exposed. It is desirable that this matter should be settled by experiment, which will doubtless be looked after before the case is heard of again. But, whatever may be true of these particular fires, we have no hesitation in stating here that, in our experience, the consumption of a gas-fire capable of doing any good in warming a room of ordinary dimensions seldom falls short of 30 cubic feet per hour, and is often more. As Mr. Hall truly says, "gas-fires are "a luxury, and, if not used with great care and intelli- "gence, an expensive one." We have on several previous occasions protested against the suicidal practice of underrating the probable costliness of these appliances. It is a practice of the makers to represent the ordinary consumption of a gas-fire of the size in most general use as being after the rate of 17 cubic feet per hour. This may not be a false statement, since it is possible that, at the lowest pressure at which the "fire" can be burnt at all, this may be its actual rate of consumption. These goods, however, are made for sale, and do not carry any guarantee of their performance. Consumers need reminding also that if a gas-fire should happen to be left alight, it will continue to burn day and night until stopped; unlike a coal-fire, which saves the householders' pocket by going out if not constantly attended to. We do not advise gas managers to discountenance the use of gas-fires; but they owe it to their customers and to themselves not to foster any illusions in regard to the cost of such appliances. If exhibited in a show-room of gas appliances, as is commonly done, they should be separately metered, and the true average consumption and cost placarded for the information of all whom it may concern.

The Meeting of the Manchester Institution.

The members of the Manchester District Institution of Gas Engineers held a very satisfactory meeting last Saturday, under the presidency of Mr. Charles Armitage, of Lancaster. Two papers were read and discussed—one by Mr. Harrison Veevers, of Dukinfield, on the use of oxygen in purification; the other by Mr. W. R. Chester, of Nottingham, the President-Elect, upon a strange explosion which happened last July at the products works of the Nottingham Corporation Gas Department. The weather was greatly against the Institution; and there were other strong local attractions for those who dared to venture from home. But the attendance notwithstanding was very fair, and the quality of the papers and discussions such as to amply reward the faithful who came to support the Chair. Neither Mr. Veevers nor the speakers upon his paper had anything very definite to say about the advantages of oxygen as an aid in gas purification, beyond testifying generally to its being convenient, and in nowise dear or troublesome to manage. As we remarked in connection with Mr. Stenhouse's contribution to the literature of the subject, on the occasion of the Rochdale meeting of the Institution, this question of the use of oxygen in purification cannot yet be disposed of in one sense or another. When one reflects upon the time that has passed, and the work that has been done by all the arts and industries, in manipulating the oxygen that is to be had for nothing (provided one does not object to its companion nitrogen) in the atmosphere, it becomes evident that the advantage of paying anything for oxygen "neat" can only be demonstrated by experience that appears painfully slow in action to those who are interested in pushing this novelty. It should be an encouragement to these pioneers to learn that, as a rule, those who have had most to do with oxygen like it best. Mr. Chester's paper dealt with a matter of limited interest, looked at from one point of view; but there is a sense in which any instance of the explosion of gas or of inflammable vapour in connection with gas making has lessons of general applicability.

A Serious Allegation.

The task of the Labour Commission is nearly done. An immense bulk of statement and counter-statement has been accumulated with reference to the conditions of employment in British industries; and how human wit is to deduce any sensible conclusion from it all, passes ordinary comprehension. The plan adopted by the Commission of allowing everybody who could make out a right of *locus standi* to tell his own tale, even though he flatly contradicted the man who spoke before him, or even for the sake of the contradiction, is simple and apparently fair; but it tends to most terrible prolixity. It may be doubted also whether it is the best arrangement for eliciting the truth. There is some satisfaction in knowing that trade unionists,

who imagined they had only to make statements sufficiently sensational to get them accepted by the Commissioners as readily as they appear to be by some soft-hearted Bishops and Cardinals, have been exposed; but it is a hard task to sift out grain from the mountainous chaff that has been emptied out before the Commission. How to estimate aright the intrinsic importance of any piece of evidence seems a hopeless question; yet it is certain that some witnesses have told the Commissioners more in a few words than others have been able to do in hour after hour of talk. Take such a statement as that of Colonel Stanley Bird, that workmen in the London building trade do not perform half the work now that they formerly did in an hour, notwithstanding the increased wages they receive and the greater purchasing power of these wages. This witness meant to imply that, according to his belief, the Trades Unions have taken away the men's interest in their work; so that, instead of trying to work fairly and well, the men so influenced do as little as they can. "We "get a good deal less out of the men now per hour than "we ever did. A bricklayer would formerly lay 1000 "bricks in a working day of ten hours; but now a man "will not lay more than 300 to 400 bricks in a day of nine "hours. The letting of brickwork is now at 90s. a rod, "instead of from 30s. to 40s.; and in the joinery trade, from "the same cause, it costs as much now to produce the "same work by machinery as when the men had to do the "whole of the work by hand." So said the witness, who admitted that his allegations were serious, but declared them to be made with full knowledge. Serious, indeed! Why, the whole epitome of Trades Unionism is here. Such assertions as these can easily be disproved if erroneous; but assuming, for the sake of argument, that Colonel Bird was speaking the truth in this matter, there is a grand opening for somebody to bring forward an instance of any description of work having been improved in quantity or quality under Union control. Let us hear the other side, if it has anything to say upon this head.

A Point Commonly Overlooked.

How difficult it is to convey true views of the problems of the gas industry to the general public, is an old discovery of the gas technician; but it might have been thought at least probable that the writers in a journal so nearly related to the industry as the *Engineer* would know something about it. This is evidently not the case, however; for, not long since, that paper published a long article upon the use of the producer, in which it was stated that the possibility of making illuminating coal gas by a cupola process, whereby the whole of the combustible portion of the coal would be turned into "producer gas, "enriched by the use of steam or carbon dioxide," while "simultaneously disposing of the coke," had been "over-"looked," and "was in danger of being completely "ignored," until Professor Emerson Reynolds "empha-"sized the necessity of replacing the ineffective and waste-"ful process of destructive distillation by the more drastic "dissolution that takes place in a producer." Our contemporary went on to remark that "the eminently practical "gas manager has for some time produced a gas of "comparatively low illuminating power, and enriched this "in illuminating constituents by adding to it water gas "charged with heavy hydrocarbons formed by the judicious "cracking of mineral oils. He has only to extend his "system," we are told, "to substitute producers for "retorts, and to increase his enriching plant, to accomplish "the object" of concocting a cheap heating and lighting gas, which would avoid the difficulty of a separate distribution of the former, and also cure the "odourless nature "of a gas rich in the extremely poisonous carbon monoxide, "which has so exercised our hygienists." We smiled over this artless composition when it first appeared, and did not take much notice of it; but now that it has been copied in full into the *Journal of the Society of Chemical Industry*, whence it may travel far, it seems necessary to say something upon the subject. This comment need not be very lengthy; and it would be almost enough for our purpose to refer to the ancient proverb about the advisability of the cobbler sticking to his last, or to the even more pointed remark as to the reliable experience of grandmothers in the matter of sucking eggs. Lest this way of dismissing the subject should be considered rude, however, we will offer our contemporary all necessary assurance that the "eminently practical gas manager" referred to by the writer, whom, to our regret, we cannot compliment in the same terms, knew all about producer gas before Professor Emerson Reynolds talked at large upon this subject for the delectation of the members of the Society of Chemical Industry. He has long used "producers" for heating his retorts withal; and he will have no objection to converting the latter into producers of gas for sale, when the guardians of the public interest in this respect relinquish their present prejudices in regard to illuminating power, sulphur purification, and the other points of what the law of the land holds to be gas fit for sale in the United Kingdom. These prejudices may be silly; and they are certainly expensive. But it is really not for the gas manager to make the law; his duty is merely to make the kind of gas which the law prescribes.

Mr. W. Sapey, son of the late Mr. E. Sapey, Manager of the Tamworth Gas Company, has been appointed Secretary of the Company.

The Gasholder Patents Case.—We learn that Messrs. Ashmore, Benson, Pease, and Co., Limited, have decided to appeal to the House of Lords against the judgment of Lords Justices Lindley, Lopes, and A. L. Smith (see *ante*, p. 818), reversing the decision of Mr. Justice Kekewich in the case of *Gadd and Mason v. The Corporation of Manchester*.

Mr. W. Woodall, M.P., Financial Secretary to the War Office, has received, through the French Ambassador (M. Waddington), the Insignia of the Legion of Honour, in accordance with a decree of the President of the Republic, and on the nomination of M. Ribot, Minister of Foreign Affairs. It is understood that the dignity has been conferred in acknowledgment of Mr. Woodall's services at the Paris Exhibition of 1889.

The Mechanical Equivalent of Heat.—A re-determination of the mechanical equivalent of heat has been made by M. Miculesen, at the Sarbonne, Paris; the method employed being water friction at constant temperature. According to *Nature*, the mean of thirty-one values ranging from 426·21 to 427·12 was 426·70 in kilogrammetres per calorie. For the normal scale of the hydrogen thermometer, this would be 426·84, or rather lower than the figure usually accepted.

The Treatment of Workmen Overpowered by Gas.—With the view of minimizing, as far as possible, fatalities resulting from the inhalation of coal gas by workmen engaged in dealing with live mains, Messrs. John Aird and Sons are about to issue to their foremen main layers a circular of instructions, prepared by Dr. G. Hastings, to be followed in the event of any accident of the above-named nature occurring. Although, owing to the great dissemination of knowledge as to the care of the injured which has resulted from the formation of ambulance classes of late years, the proper treatment of suffocated persons is now more generally known, Messrs. Aird are none the less to be commended for placing in the hands of their responsible servants definite information on this matter, prepared by a competent medical authority, especially having regard to the great extent of their main-laying operations.

Water-Gas Works for the Brussels Municipality.—It has been decided to build complete water-gas works at the Brussels municipal gas-works at Laeken; and a contract has already been entered into with Messrs. Humphreys and Glasgow, of No. 9, Victoria Street, S.W., for the erection of the generating plant. This has been designed to minimize the production of carbon dioxide; and the purification, as in the case of coal gas, will be exclusively with oxide of iron. The ultimate capacity of the water-gas works, as now laid out, is about a million cubic feet daily; the present installation covering half of this quantity. The Administration at one time contemplated the distribution of two qualities of gas in the 24 hours—one during the hours of daylight, for heat and power service; and a richer quality during hours of illumination. It now seems, however, that the price of oil is sufficiently low to make such distinction inadvisable.

The Large Gasholder at Beckton.—The largest gasholder of The Gaslight and Coke Company is at their Beckton station. It has been in course of construction during the year by Messrs. C. and W. Walker, of the Midland Iron-Works, Donnington, Shropshire, from the designs of Mr. G. C. Trewby, the Constructing Engineer of the Company, and is now in full operation, supplying gas to London. It is a valuable addition to their storing power, already so large, as demonstrated in the letter of Colonel Makins, the Governor of the Company, to *The Times*, during the fogs of the present month. The tank is of concrete, built by Messrs. Lucas and Aird. It is partly raised above the surface of the surrounding land; and the 28 steel standards by which the holder is guided are about 200 feet high from the ground. The height of the standards will be appreciated by comparing them with the Monument, which is 202 feet high. The holder has been finished for some time, has been thoroughly tested, and has, we believe, given the highest satisfaction to the Company. It has four lifts, and is of the capacity of 8 million cubic feet.

WATER AND SANITARY AFFAIRS.

In further explanation of his views with reference to the London Water Supply, Dr. Percy Frankland supplements his evidence before the Royal Commission by a letter addressed to the *Pall Mall Gazette*, recounting the results of his bacteriological investigations, commencing in 1885. In 1888 he found that out of every 100 micro-organisms present in the unfiltered Thames water, 98·4 were removed by the treatment which the water received in the Companies' works. In 1886 and 1887, the percentage of removal was nearly as good. These striking results, since confirmed by other observers, are described by Dr. P. Frankland as having "undoubtedly profoundly "modified the question of water supplies from river and "other surface sources." The importance of this fresh light is said to consist in showing the great difficulty which any micro-organism, whether harmless or not, must experience in passing through the Companies' works, and so reaching the consumer. Speaking of the pathogenic micro-organisms, which alone need be considered, these are described as having first of all to traverse a certain length of the stream—a process during which many will be deposited in the river bed. Those that reach the intakes will be carried on into the storeage reservoirs, where others from among them will subside while the water is at rest. They will also have to contend with the regular water bacteria, who will still further help to reduce their number. Finally, there will be the sand filters, which have exceeded all expectation in the extent to which they have arrested the bacteria. Supposing some of the pathogenic germs to pass "all these barriers," their number will be so reduced, and their powers of mischief so diminished, that, although "theoretically such mischief "may not still be absolutely impossible," proof will be required to show that any evil actually ensues. Such is the gist of Dr. P. Frankland's statement; and its importance can scarcely be over-rated. The advance thus made in our knowledge as to the relation between the water supply and the micro-organisms is of immense practical value. Before 1885 there was no assured information on this subject; and apprehension existed as to the extent of the danger besetting a river supply. Even when Dr. Koch's method of gelatine plate culture came into use, there was a tendency to misunderstand the results. The errors thus made were clearly exposed in a paper, read by Dr. Percy Frankland, at the International Congress on Hygiene last year. As far back as 1885, he had called attention to the enormous multiplication of which some microbes are capable even in the purest waters, including distilled water itself. Hence water of the purest character may contain immense numbers of micro-organisms, providing that the opportunity for such multiplication has occurred. The necessity for discrimination in dealing with the mere numerical results is abundantly shown by a portion of the evidence given before the Royal Commission by Dr. E. Ray Lankester, who stated that 73 bacteria colonies in a cubic centimetre of water, taken direct from the river, might increase to half a million in 24 hours; whereas if the water had remained in the river, there would not have been any increase. Dr. Lankester remarks that "this "circumstance very much vitiates the weight of observa-"tions which have not been made immediately upon the "removal of the water from its natural source." Dr. P. Frankland, in the paper he read before the Congress on Hygiene, while deprecating absolute dependence on numerical results, asserted the peculiar importance of the bacteriological method, in determining the hygienic value of purification processes. On this point there can be no doubt; and its practical bearing is obvious.

The New Six-Lift Holder at East Greenwich.—Mr. J. S. Hazard, of No. 11, King William Street, Greenwich, has sent us some extremely well-executed photographs of the new East Greenwich holder of the South Metropolitan Gas Company (which we erroneously described last week as having five lifts, whereas it actually has six lifts, the two top ones rising above the guide-framing). The structure is admirably illustrated by a set of three photographs; one showing the holder fully raised, another showing the guide-framing, and the third—quite a triumph of *technique*—being a view taken inside the tank to show the supports for the crown. An exposure of an hour and a half was required to obtain a successful negative in this instance; and the result is a wonderfully distinct picture of the orderly maze of props and pillars. The set forms a valuable record of a remarkable work.

ESSAYS, COMMENTARIES, AND REVIEWS.

GAS AND WATER COMPANIES IN THE STOCK MARKET.

(For Stock and Share List, see p. 962.)

The general position of business on the Stock Exchange seems to have gone right back to what it was some two or three months ago, when everything was regarded very cautiously, except the really gilt-edged securities. What little fillip had been lately gained by the ordinary and more or less speculative business, dwindled away to nothing; buyers were nowhere; and whenever a profit could be snapped, it was taken. Prices fell away accordingly; and the tendency of the week may be written down as distinctly flat. The Money Market just about maintains its equilibrium—the chances of a continuation of the present rates being, if anything, rather confirmed; but there is not much indication of any significance either way. The Gas Market is still very quiet—only a shade more active than it was in the preceding week. Reviewing the chief and leading issues, the prevailing tendency was in favour of steadiness. But while these have not advanced in value, one or two minor stocks have receded; so that, on adjusting the balance, there are certainly more retrogressions in point of quotation than advances. Gaslight "A" was very steady, and changed hands daily at about a point above or below 220, with a closing mark of 220½. A very fair amount of business was done in the debenture, preference, and limited issues; but, notwithstanding the general demand for good investment stocks, the prices of the "J" 10 per cent. preference and the "H" 7 per cent. limited underwent a slight reduction. South Metropolitans were quiet; nothing at all being touched, but the "B," which held on well to about the middle price. The Company will sell at the Mart, on the 9th prox., £25,000 of debenture stock; and the present existing demand for high-class securities is all in favour of good prices being realized. Commercials were quiet and unchanged. The Directors of this Company are inviting tenders for the unaccepted balance of their last issue of debenture stock; and here also good prices may be expected for a choice article. The Suburban and Provincial Companies furnish two instances of a decrease in price—Bristol and British having both come down slightly; but there is not much business doing in any of them. The Continental Companies met with very little attention; but they held their own without difficulty. The South Americans are still favourably affected by the boom on the River Plate; and Buenos Ayres and Monte Video have each gained another ½. The rest present no special feature. Water was fairly brisk; and although East London fell away 1, the general tendency was good.

The daily operations were light, and may be thus briefly summarized: Business in Gas was quiet at the opening, and so remained, without any variations in value. Tuesday was the counterpart of the preceding day. Wednesday was fully as quiet as either of its predecessors; but an advance of ½ was effected by Buenos Ayres and Monte Video. Thursday's operations were almost entirely restricted to Gaslight issues, which remained unchanged, although one or two of them did not command the highest prices of the week. Bristol fell 1½. In Water, East London dropped 1; but New River debentures rose 2. There was some falling away of Gas prices on Friday. Gaslight "J" receded 1½; ditto "H," 1; and British, 1. Lambeth Water rose 1. Saturday produced no incident of interest; and all quotations remained unchanged.

ELECTRIC LIGHTING MEMORANDA.

The Institution of Electrical Engineers Dinner—An Exercise in Definition—Experiments on Induced Currents.

The Institution of Electrical Engineers have had their annual dinner—the President (Professor W. E. Ayrton, F.R.S.) in the chair. This function is usually taken advantage of for procuring blatant advertisement of the position and prospects of electric lighting. This time, however, there was nothing of the kind; and consequently the good speeches of hosts and visitors form very pleasant reading. The guest of the evening was Mr. Mundella, President of the Board of Trade, between whom, in his official capacity of "Earthly Providence" to the British electric lighting industry, and the representatives of the industry, there exists what may not inaptly be styled an alternating current of administrative control and tentative suggestion. The Board of Trade is heartily abused very often by energetic electricians who are restrained by its agency from doing as they please; but the open-minded among these ambitious gentry know that the President is the last man to countenance anything like mere official meddling with a young and promising industry. Mr. Mundella is credited with having been instrumental in relaxing the legislative restrictions upon speculative electric lighting which, though serving a good purpose in 1882, were afterwards found to hamper legitimate enterprise in this direction. Speaking at the dinner, however, he took the opportunity of reminding his entertainers that the real justification for the Act of 1888 would be the commercial prosperity of those undertakings which have taken advantage of it for raising money for employment in central station electric

lighting. This is the centre of the position at present occupied by the electric lighting companies; and it is clear that Mr. Mundella, as a prudent administrator and experienced man of business, is not at all inclined to take credit for whatever share he may have had in the legislation of 1888, until he sees that the money applied under it brings in a reasonably good return to the investors. Professional electricians speak well of the Act, because it has enabled them to find a good deal of profitable work in different parts of the country; but something more must result from the operation of the statute before it can be finally adjudged successful.

In the course of his speech to the assembled electricians, the President of the Board of Trade scored very neatly, at the expense of the Committee on Electrical Standards, over their report, which, as he said, it will be his duty to present to Parliament and to the Queen. It was with reference to the old trouble of defining electrical units of measurement. After expressing his sense of the obligation under which the Board of Trade rests to the eminent authorities who served on the Committee, and who have "so greatly advanced our knowledge of electricity," Mr. Mundella went on to remark that he could not do better than read the report, which is in one sentence without punctuation, and runs as follows: "That an alternating current of one ampere shall mean a current such that the square root of the time average of the square of its strength at each instant in amperes is unity." Naturally, the reading of this singular attempt to define the inexplicable was received with a shout of Homeric laughter, which was renewed as the speaker told how he had asked Sir Thomas Blomefield to explain this proposition, only to receive the assurance of that candid gentleman that he knew nothing about it. "Sir Courtenay Boyle," said Mr. Mundella, "was not so candid; but he suspected that his friend Sir C. Boyle knew just as much as his colleague." Whether intelligible or not, the formula is an interesting thing to place upon record as an illustration of how well electricity is understood in the latter end of 1892.

Some remarkable experiments upon electrical induction have been in progress under the direction of Mr. W. H. Preece upon the coast near Cardiff; the immediate object being to try whether electrical communication by induction can be established between a ship at sea and the shore. For this purpose a wire was run for a distance of about a mile along the shore, and another wire parallel to, and at a distance of three miles from, the first, was erected upon the island of Flat Holme, which represented the ship for the occasion. The shore line was furnished with a powerful generator, and the island wire with a sounder to receive the messages. The result was that the signals made in the land wire were heard on the island with perfect distinctness. The underlying principle of this method of communication, being nothing else than etherial vibration, and therefore analogous to the method by which light is transmitted through space, is manifestly susceptible of development to an extent which has no apparent limitation. The different expressions, so to speak, of undulatory motion of the cosmic ether are thought to be due only to differences of wave-length. Some undulations affect the eye as light; others are known to us as heat; others, again, of vastly different amplitude, are called electrical. Every order of undulations has its peculiar properties in relation to what we call matter. For example, vulcanite is opaque to light, the undulations constituting which will not pass through this particular substance, although they will through glass. On the other hand, the so-called Tesla currents of electricity, with their million or more of alternations per second, will pass through vulcanite as though it were not present; while the same material will stop the ordinary electricity of the dynamo. Induced currents of electricity have the property of clearing intervals of space, under certain conditions, just like light in the ether or sound in air. How far this property can be utilized and its manifestations controlled, cannot be pronounced upon at present. It is even possible that the problem of selective generation and collection of ether undulations, discussed by Professor Crookes in the *Fortnightly Review* early in the year, may be shown to be attackable by the way of induction; but this is a very hazy subject. If we could only make and deal with just the order of ether waves we need for any particular purpose, the saving of energy, which for the time being practically means coal, would be stupendous. These are dreams for the present. But there is hope in the reflection that, in the history of the world, some dreams of one generation have been the realities of succeeding ones; and this may be of the realizable class.

THE NEED FOR THE COMMERCIAL STANDARD IN INDUSTRIAL UNDERTAKINGS.

In all great ndustries—such as that of gas manufacture and supply, railways, steam navigation, iron manufacture, or cotton spinning—a little observation will distinguish two lines of development, the scientific or technical, and the commercial; the connection between them being sometimes close, and in other cases appearing to be slight and distant. The technical development generally has reference to commercial considerations, because the basis of all industries must be a trade one, although sometimes it deals with other aspects of an industry, such as its social or sanitary relations and effects. The commercial development, on the other hand, only uses the light of science as a guide to the attainment of its own ends, never regarding technics as an end in itself. Herein, it may be remarked in parentheses, lies the difference between a trade and an art; for the true artist cares for his art alone, which is to him both means and end. An industry, on the contrary, is never conducted upon this principle. Nobody, for example, ever made gas, or steel, or cotton goods for the love of the work. Not to dwell upon this part of the subject, however, we will proceed to the consideration of a third aspect which some great industries present to the critical observer—the settled character of an established undertaking which belongs to some essentially commercial enterprises such as that of gas and water supply, tramways, and even railways. In the eyes of a considerable school of modern publicists, this is the most important property of these industries, inasmuch as it enables them to be converted from mere trades into appanages of national or municipal government. It is not to be denied for a moment that the most settled of established undertakings of the class now in question still preserve the commercial basis upon which they were originally launched into existence; and the problem of how far the character of trade venture has been eliminated from them, is one to be solved with regard to considerations that vary with every separate example. The importance of this problem consists in the truth (not always sufficiently appreciated) that the gains of trade, wherever these are at all speculative, can only be secured by the operation of the trade spirit. Trade is for the trader, not for the administrator. The view of the modern Socialist is apt to confound the two persons.

This confusion was made apparent in the statements of Mr, Tom Mann before the Labour Commission. This witness—a very fair representative of a class—was for nationalizing or municipalizing everything. Railways are to be taken charge of by the State; docks and wharves by municipalities or provincial representative bodies; while gas and water supply, tramways, and many other matters, are regarded as admitted departments of the public service. Even Tom Mann, however, is prepared to draw the line somewhere. He declares himself distinctly favourable to State control of railways at once; and he is an advocate of the nationalization of land. He believes that the time has come when every well-conducted municipality can undertake the supply of light and water; and in some cases he goes farther—favouring the idea of municipalities undertaking the building of all public institutions, the making of furniture for those institutions, and the clothing for all public officers and servants. To the questioning of the Duke of Devonshire, however, he admitted that it has not been possible hitherto to conduct such a trade as cotton manufacture by State or municipal control.

This is how the matter appears to stand at present: There are certain industries which are believed to have reached such settled maturity of methods, and to have become so firmly established in the world, that the enterprise of the trader can be dispensed with in their case, and they can be handed over to disinterested administrators, to be carried on for the public benefit. Other industries there are which are not yet regarded as quite ripe enough for this style of treatment; while others again seem to be outside all present possibility of control save upon trade principles. Meanwhile, for the industries of the first order, which are already supposed to be comfortably enclosed within the ring-fence of municipalism, development along commercial lines is taken as finished, and technical improvement is consequently to proceed, if at all, without reference to commercial considerations.

Speaking now with particular reference to one of these ripe industries—one of the very ripest, gas supply—we venture to express a doubt as to the perfection of the process by which this ripening has been effected in this case. It is the statutory protection of the gas industry, of course, which has prepared it for this fate of being gathered by the hand of the Socialist, disguised as the administrator of local self-government. Fortunately, this protection has not in this country been based upon principles antagonistic to, or altogether ignoring, the commercial development of the industry. This might have happened; and it has been brought about in certain instances. The British principle of leaving gas companies with a "loose end" in the matter of the actual selling price of gas, is to be credited with whatever sound commercial working exists in this protected industry. But, after all, the liberty of statutory gas companies has not gone very far. The most enterprising of them are weighted by the privilege of being empowered to cover bad management by a stroke of the pen; and when a gas undertaking is taken over by a public authority, all past errors are condoned, while their consequences are perpetuated. The condition of the gas industry might have been different from what it is to-day if, alongside the protected undertakings, there had been others working with a free hand. This observation must not be misunderstood as implying that two or more gas companies occupying the same, or adjoining districts under competitive management would be likely to do one another good, either now or in any past era; but only that the free play of commercial considerations might conceivably have altered the British gas industry if it could have been secured without the waste of actual competition—so totally unsuited to develop this class of industry.

To illustrate our meaning, let us cite the condition of the

national undertakings of the Post Office and the Royal Navy. The former is often mentioned by Socialists as an example of excellence and economy in the working of a Public Department. Apart from the fact, however, that men of business who have much to do with the Post Office do not share the admiration which *dilettante* Socialists profess for it, how is the efficiency of the postal service maintained, and by what power is it caused to extend from time to time into new and useful developments? Entirely by the pressure of public opinion, instructed by the triumphs of innovators from without, who would soon beat the Post Office on its own ground if they were left alone. It is the same with the Navy. What could the Admiralty ever have done without the example supplied by the unprotected steamship owners? The latter illustration is really a most striking one. Every improvement in steam navigation has been forced on by sheer commercial necessity. Who produced the means of carrying cargo and passengers—the former with modern economy of coal, the latter at the modern standard of speed—but the traders and carriers who adopted the smallest improvements of the ship and machinery builders, albeit these have resulted in putting out of use whole fleets of vessels that once kept the seas, and might do so still if strength and seaworthiness were the only considerations? No Public Department would have acted in this way. The Navy, moreover, owes to the private shipowners not only the improvement of propelling machinery, but also a standard of work in the stoke-holes and elsewhere. It would have been simply impossible for a department of the public service to have set the standard in this matter of labour either on board ship or in the dockyards. All public services tend to perpetuate the conditions under which they start. Nobody will take the responsibility for initiating innovations which are certain to offend somebody; and the speed at which vested interests grow up in a protected industry is notorious.

The gas industry has had no concurrent free companion to set the pace, as the steamship owners have done for the Royal Navy. All its work has been measured, not by what is necessary in order to make a living in a hard world, but by what will secure a 10 per cent. dividend. Does anybody really believe that if the Transatlantic, Oriental, and Cape liners had had a 10 per cent. dividend guaranteed, we should have seen triple-expansion engines and the other contemporary developments of marine engineering? Never. It is the possibility of failure that impels to success. Tell a man that not only shall he never starve, but that he shall even be able to depend on receiving a comfortable pension, contingent on his behaving decently well, and the odds are greatly against his doing much beyond "marking time." This is precisely how the gas industry has been coddled. Here and there a strong spirit has arisen, who would persist in doing things which he *need* not have done to earn his employers their maximum dividends; and he has usually made as many foes as friends, if not more. The inquiry of the *laissez-faire* Premier, Lord Melbourne, addressed to all ardent reformers and innovators, was, "Why can't you let it alone?" And this is the cry of half the gas-works administrators going. They want to be let alone, to do what is safe and comfortable, and does not involve them in any risk. And, certainly, these people have much reason on their side. Why should they fret and study, and vex themselves over their work, when the 10 per cent. dividend can be assured by a vote of two or three good fellows of directors, who will face the shareholders at the next general meeting with the assurance that everything has been done to manage the undertaking in the best possible manner? Who cares for putting another 2d. or 3d. per 1000 cubic feet on the price of gas, when somebody is sure to rise in the shareholders' meeting and express surprise that the directors did not make the advance twice as much while they were about it? This is the direct result of there being no free gas companies working upon a purely commercial footing. The nearest approach we have to anything of the kind are the coal-carbonizing and shale-distilling concerns; and these are in a bad way just now. Poorly off as they are, however, they are better worth the attention of the budding gas engineer than the monumental works where they put the station meter in a temple, and spend any amount of money in demonstrating that gas manufacture requires neither brains nor common aptitude in business, so long as there is a good Act of Parliament to fall back upon. If the undertakings which abuse the statutory protection that alone prevents them from falling to pieces, devoted the energy saved by the neglect of commercial considerations to the furtherance of technical progress, there would be something to be said for them; but it is not so. If one wishes to learn technics, it will be useless to go to the gas administrators who get the most for their product. They say in the States: "It's git up and git that makes men great;" and even though one may not be able to subscribe to this sentiment, regarded as summarizing the whole duty of man, it is not to be denied that absence of the need for bustling about in business is apt to result in stagnation.

The Water-Gas Plant at the Copenhagen Gas-Works.—The water-gas plant referred to in last week's issue (p. 897) is being erected at the Western works of the Copenhagen Corporation (of which Mr. N. O. Peterson is Manager); and not at the Danish Gas Company's works, of which Mr. Marshall has control. It was the former gentleman who visited America last spring, to inspect the various water-gas plants there in operation; not Mr. Marshall, as was stated by inadvertence.

NOTES.

The Action of Carburetted Water Gas on Meter Diaphragms.

It was remarked, at the time when water gas was first made for sale in the United States, that serious difficulty was frequently experienced in consequence of the solvent action of the oily deposit from the imperfectly-made gas upon the white lead putty ordinarily used by gas-fitters. Connections which were perfectly sound and tight for coal gas would allow water gas to escape in serious quantity. Whatever may be the case now, the difficulty at the time was only overcome by the substitution of plumbago for lead in the preparation of putty for screwed joints in gas connections. It is now rumoured that more than one of the English gas companies who have experimented with water gas and with enrichment by means of petroleum spirit, are beginning to find the diaphragms of dry meters, and of street lamp and other governors, showing signs of the altered conditions of the service. After many trials with different descriptions of oil for diaphragm dressings, meter makers have found that almond oil gives the best results by way of resisting compounds deleterious to leather which coal gas, made in the customary way, deposits in the course of prolonged exposure. No rational explanation of this has ever been given; but the fact remains that almond oil is the only agent known to the British dry gas-meter trade, whereby the leather diaphragms of such meters can be kept supple and gas-tight. It is this consideration which lends importance to the rumours respecting the failure of almond oil to withstand the insidious effects of carburetted water gas. If American experience has revealed a means of dealing with this threatened difficulty, it is high time for the fact to be communicated to British technicians.

The Quality of Durham Coke.

In his Inaugural Address upon taking the chair, Mr. Hawdon, President of the Cleveland Institution of Engineers, animadverted upon the unsatisfactory character of present makes of Durham oven coke. He declared that Cleveland pig iron makers now have to use a quality of coke such as would not have earned for Durham oven coke its high reputation. What is described as fairly good blast-furnace coke now contains 9 or 10 per cent. of ash; and Mr. Hawdon lamented that the days of main seam coke of hard silvery brightness and ash as low as 5 per cent. are fast passing away. This coke was manufactured in the Durham coal-field by means of the old-fashioned open-top beehive oven. This apparatus only yielded from 50 to 53 per cent. of coke to the manufacturers; but it sold for 8s. 6d. per ton in 1865, and was so far proof to the gases in the blast-furnaces that, instead of yielding to them in the upper portion of the furnace, it was found down at the tuyeres in bulk to complete the melting of the ironstone and the fluxes. Present-day oven coke, containing 8 to 10 per cent. of ash, and yielding 58 or even in some cases 68 per cent. to the maker, is stated to be the product of an inferior class of coal, and to be drawn three times instead of twice a week. Mr. Hawdon did not say anything about the effect of recovering bye-products upon the coke; and it would be interesting to hear an independent iron manufacturer's views upon this subject. Seeing, however, that the inferior oven coke that is complained of by Mr. Hawdon costs 13s. 6d. per ton delivered in Middlesbrough, the North of England coke trade should be in a very satisfactory condition.

A Well-Known Phenomenon Explained.

A striking example of the way in which novel observations are continually being made with regard to common phenomena, occurs in some fragments of a paper which the late Mr. James Thomson, F.R.S., intended to write upon the appearance of rays proceeding from artificial lights when viewed through nearly closed eyes. The incomplete records of Mr. Thomson's observations have been presented to the Royal Society by his brother, Lord Kelvin, who has added to them some remarks of his own upon the same subject. Mr. Thomson describes the phenomenon as consisting of an appearance as of tails or rays of light from any lamp when the line of sight from the eye passes close to either the upper or the lower eyelid; and he remarks upon the peculiarity that it is possible, by a careful movement, to shut off the vision of the light itself, and keep the rays or tails in sight. Street gas-lamps seen from a short distance lend themselves readily to a number of little experiments of this kind, which go to show that the part played by the eyelids in these observations differs altogether from anything that can be done by means of a card, or other extraneous occulting shutter. The curious point is that although, as Lord Kelvin says, the phenomenon in question must have been noticed millions of times during the past 3000 years, no attempt seems to have been made to explain it, although, as it now transpires, Mr. Silvanus Thompson has dealt with it in his class lectures, giving the same explanation as is offered in the name of Mr. James Thomson. This is simply that in the normal eye there is a layer of moisture between the eyeball and the lids, which collects at the edges of the latter in a lens-shaped rim, so to speak: and it is when the rays from a lamp have to pass through these lenses, or either of them, that the effect under notice is produced.

TECHNICAL RECORD.

MANCHESTER DISTRICT INSTITUTION OF GAS ENGINEERS.

The Ninety-second Quarterly Meeting of this Institution was held on Saturday last, at the Grand Hotel, Manchester—the PRESIDENT (Mr. Charles Armitage, F.C.S., Assoc.M.Inst.C.E., of Lancaster) in the chair. The attendance of members was large; but several letters of apology for absence were received.

THE MINUTES.

The HON. SECRETARY (Mr. S. S. Mellor, of Northwich) read the minutes of the previous meeting, which was held at Rochdale; and they were confirmed.

NEW MEMBERS.

The following gentlemen were unanimously elected members of the Institution: Mr. S. Glover, of St. Helens; Mr. R. G. Shadbolt, of North Bierley; and Mr. John Wilcocks, of Shipley.

ELECTION OF PRESIDENT.

The next business was the election of President for 1893-4.

Mr. C. E. JONES (Chesterfield) said it afforded him very great pleasure to submit the name of a gentleman who would, he was sure, receive the hearty support of the members, both for his eminent scientific attainments and his social virtues. On a former occasion, when proposing Mr. W. R. Chester, of Nottingham, for the vice-presidency, he expressed his high sense of that gentleman's ability and services to the profession; and he could now only repeat what was then said. It would give the members much satisfaction to see Mr. Chester in the chair; and his election would be of advantage to the Institution. The Committee were unanimous in recommending his name to their consideration; and he (Mr. Jones) had the greatest pleasure in proposing that the recommendation be confirmed.

Mr. T. B. BALL (Rochdale) seconded the motion, which was carried with applause.

Mr. CHESTER acknowledged the honour which had been conferred upon him, and said that during his presidency it would be his endeavour, as far as lay in his power, to promote the interests of the Institution. He knew that, in accepting this position, he followed a long line of gentlemen who had occupied the chair with honour and dignity; and he would try to follow in their footsteps in some humble way, so as to leave the interests of the Institution at the end of his year of office in a no less advanced position than at the time he accepted it.

PAPERS READ.

Mr. HARRISON VEEVERS then read a paper on "The Use of Oxygen in the Purification of Coal Gas;" and Mr. CHESTER followed with one giving "An Account of a Recent Explosion in a Tar-Well." These appear elsewhere to-day; and our report of the discussions which took place upon them will be published in next week's issue.

At the close of the business on the *agenda*, the members took tea together.

THE GENERATION OF LIGHT FROM COAL GAS.

Professor Vivian B. Lewes's Cantor Lectures at the Society of Arts.

On Monday last week, Professor VIVIAN B. LEWES, F.I.C., F.C.S., Chief Gas Examiner to the Corporation of London, delivered, at the Society of Arts, the first of his series of Cantor Lectures on the above subject, the general scope of which has been already indicated in the JOURNAL. The lecturer devoted his opening discourse to a review of the earlier researches of the present century on the subject of the composition and luminosity of flame; illustrating his remarks by some interesting experiments.

Professor Lewes began by remarking that, if any excuse were needed for choosing the development of light from coal gas as the subject for his lectures, he could not conceive a better one than that the first hundred years of gas lighting have now been completed, and that it behoves us to review what has been done in the past, and may yet remain to be done in the future—to survey and criticize the position of our great gaseous illuminant, and see to what extent that position is likely to be assailed, and how far weak points may be strengthened. The centenary of gas lighting awoke many thoughts of the past; and as the early struggles and final victory of gaseous illumination were passed in review, one could not help feeling that, complete as that victory had been, many changes would have to be made in the future to ensure the advantages which had been so hardly won. It was to the past that one must turn to see the way in which the experimental data upon which the present methods of burning gas were obtained, and also to ascertain if any threads of the tangled skein still remained to be unravelled.

The lecturer then went on to say that the close of the last century was marked by a wonderful wave of scientific activity which swept over Western Europe; and it was at this period that the county of Cornwall contained two men who were destined to shed "an immensity of light," in more ways than one, over the civilized world. In 1779, William Murdoch, then in his twenty-fifth year (having been born in Ayrshire in 1754), went to Cornwall as Superintendent Manager for Messrs. Boulton and Watt, to introduce their engines into the Cornish mines; and it was while employed in this way that he conceived the idea of making illuminating gas by the distillation of coal—an idea which culminated in 1792 by his lighting up his house and office in Cross Street, Redruth, with coal gas which had been made in a primitive form of retort in the back yard. It was thus that, a hundred years ago, Murdoch earned his title to fame by the introduction of one of the most useful applications of the past century; and, had it not been for the opposition and obstacles thrown in his way by Watt, he would have added a still greater lustre to his name by perfecting the locomotive many years before Stephenson.

At the same time that Murdoch was working at Redruth, manufacturing and introducing coal gas, Cornwall contained another most important living factor in the history of gaseous illumination. Far away at the south-western extremity of England, the town of Penzance nestles on the shores of Mount's Bay; and there it was that, on the 17th of December, 1778, Dame Grace Davy, the wife of a prominent citizen, Robert Davy, gave birth to a son, who lived to reach the highest pinnacle of scientific fame, and to shed a lustre on the chemical work done in the early days of the present century. The name of Sir Humphry Davy conjures up to the mind one of the most remarkable men, in many ways, that the past century of scientific research has developed; and in no way more remarkable than in the intensity, rapidity, and the variety of the work he did. Even in his school days, he dabbled in poetry, metaphysics, and theology; while, at the age of nineteen, he commenced to work at chemistry, and achieved a success as phenomenal in its rapidity as it was well deserved.

It was in 1797 that the first impulse towards chemistry was given to Davy's mind by reading Lavoisier's "Elements of Chemistry;" and not being satisfied by merely acquiring the ideas of the great French philosopher, he was led to experiment for himself. Notwithstanding the primitive character of his apparatus, his genius did what no amount of costly appliances could have done; and, within four months of his beginning to work at science, he had commenced writing an essay on "Heat and Light," which was published in 1799. At the commencement of 1801, he became Assistant-Lecturer on Chemistry at the Royal Institution; and, having made a deep impression by his powers as a lecturer, he became Professor there on the 31st of May, 1802. It is with the safety-lamp that his name is most widely connected; yet the whole of the research which culminated in the production of that appliance only extended over a few months. In August, 1815, while on a shooting expedition in the Highlands, his attention was first directed to the subject of fire-damp. On his way back to town, he stopped at Newcastle, and made inquiries into the circumstances attending explosions in mines, and arranged for some fire-damp to be sent to him in London. He then entered into the investigation of the matter; and, on the 9th of November, the results were given in a paper read before the Royal Society. The principle of the safety-lamp was then laid down; and the lamp itself was perfected in the following month. Having married and received the honour of knighthood, Davy retired from the Royal Institution in 1812; and he succeeded Sir J. Banks as President of the Royal Society in 1820.

Of Davy's innumerable researches, there is one which links his name with that of Murdoch and the early pioneers of the gas industry—a research which, springing out of his investigations on fire-damp, gave us the first and fundamental theory of the causes of luminosity in a gas-flame. This theory remained unquestioned and unchallenged for 50 years; and all modern research goes to confirm its broad principles. The first published work upon this subject is dated July, 1816, and consists of a "Notice of Some New Views and Experiments Respecting Flame," published in the *Journal of Science and the Arts*—a paper edited at the Royal Institution, in the second volume of which (p. 124) the following passages occur:—

> When a wire-gauze safety-lamp is made to burn in a very explosive mixture of coal gas and air, the light is feeble and of a pale colour; whereas the flame of a current of coal gas burnt in the atmosphere, as is well known by the phenomena of gas-lights, is extremely brilliant. In a paper read before the Royal Society, I have endeavoured to show that in all cases flame is a continued combustion of explosive mixtures; it becomes therefore a problem of some interest why the combustion of explosive mixtures, under different circumstances, should produce such different appearances. A very acute philosopher, who himself started the subject in conversation, suggested the idea that, in the combustion of explosive mixtures within the lamp, carbonic oxide might be formed, and that the light might be deficient from the deficiency of the quantity of oxygen necessary to produce carbonic acid. On submitting this idea to the test of experiment, it was discovered to be unfounded, for, by the combustion in the wire-gauze lamp, carbonic acid was produced in quantities as great as could have been expected from the quantity of oxygen consumed; and on adding oxygen to a mixture in quantities more than sufficient to burn the whole of the gas, the character of the light still continued the same.
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> In reflecting on the circumstances of the two species of combustion, I was led to imagine that the cause of the superiority of the light of the stream of coal gas might be owing to the decomposition of a part of the gas towards the interior of the flame where the air was in smallest quantity, and the deposition of solid charcoal, which, first by its ignition, and afterwards by its combustion, increased in a high degree the intensity of the light; and a few experiments soon convinced me that this was the true solution of the problem. I held a piece of wire gauze, of about 900 apertures to the square inch, over a stream of coal gas issuing from a small pipe, and inflamed the gas above the wire gauze, which was almost in contact with the orifice of the pipe, when it burnt with its usual bright light. On raising the wire gauze so as to cause the gas to be mixed with more air before it inflamed, the light became feebler; and at a certain distance the

flame assumed the precise character of that of an explosive mixture burning within the lamp. But though the light was so feeble in this last case, the heat was greater than when the light was much more vivid; and a piece of wire of platinum held in this feeble blue flame became instantly white hot. On reversing the experiment, by inflaming a stream of coal gas, and passing a piece of wire gauze gradually from the summit of the flame to the orifice of the pipe, the result was still more instructive; for it was found that the apex of the flame intercepted by the wire gauze afforded no solid charcoal, but in passing it downwards solid charcoal was given off in considerable quantities, and prevented from burning by the cooling agency of the wire gauze, and at the bottom of the flame, where the gas burnt blue in its immediate contact with the atmosphere, charcoal ceased to be deposited in visible quantities.

This principle of the increase of the brilliancy and density of the flame by the production and ignition of solid matter appears to admit of many applications:—

(1) It explains readily the appearance of the different parts of the flames of burning bodies, and of flame urged by the blowpipe. The point of the inner blue flame, where the heat is greatest, is the point where the whole of the charcoal is burnt in its gaseous combinations without previous deposition.

(2) It explains the intensity of the light of those *flames* in which *fixed* solid matter is produced in combustion, such as the flame of phosphorous* and of zinc in oxygen, &c., and of potassium in chlorine; and the feebleness of the light of those flames in which gaseous and volatile matter alone is produced, such as those of hydrogen and sulphur in oxygen, phosphorous in chlorine, &c.

(3) It offers the means of increasing the light of certain burning substances by placing in their flames even incombustible substances. Thus the intensity of the light of burning sulphur, carbonic oxide, &c., is wonderfully increased by throwing into them oxide of zinc, or by placing in them very fine amianthus or metallic gauze.

In the same paper, he also points out that "when cuprane or proto-chloride of copper is introduced into the flame of a candle or lamp, it affords a peculiar dense and brilliant red light, tinged with green and blue towards the edges, which seems to depend upon the chlorine being separated from the copper by the hydrogen, and the ignition and combustion of the solid copper and charcoal." Farther on in the same paper he says: "Whenever a flame is remarkably brilliant and dense, it may always be concluded that some solid matter is produced in it. On the contrary, when a flame is extremely feeble and transparent, it may be inferred that no solid matter is formed." And he concluded by pointing out that "the heat of flames may be actually diminished by increasing their light—at least, the heat communicable to other matter—and *vice versâ*. The flame from combustion which produces the most intense heat, among those I have examined, is that of a mixture of oxygen and hydrogen in slight excess, compressed in a blowpipe apparatus, and inflamed from a tube having a very small aperture. This flame is hardly visible in bright daylight; yet it instantly fuses very refractory bodies, and the light from solid matters ignited in it is so vivid as to be painful to the eye."

In another paper, read before the Royal Society in the following year, he referred to the work that is mentioned above, and said: "I have given an account of some new results on flame, which show that the intensity of the light of flames depends principally upon the production and ignition of solid matter in combustion, and that the heat and light in this process are in a great measure independent phenomena." He then goes on to describe the effect of rarefaction upon flame and explosion, and the checking effect which the admixture of various gases has upon combustion. In this connection he shows that the lower the temperature needed to bring about the combustion, the larger will be the quantity of admixed and diluting gases necessary to prevent combustion—a fact which he illustrates as follows: "There is a simple experiment which demonstrates in an elegant manner this general principle. Into a long bottle with a narrow mouth introduce a lighted taper, and let it burn till it is extinguished. Carefully stop the bottle, and introduce another lighted taper; it will be extinguished before it reaches the bottom of the neck. Then introduce a small tube containing zinc and dilute sulphuric acid, and at the aperture of which the hydrogen is inflamed. The hydrogen will be found to burn in whatever part of the bottle the tube is placed. After the hydrogen is extinguished, introduce lighted sulphur, which will burn for some time. After its extinction, phosphorus will be as luminous as in the air, and, if heated in the bottle, will produce a pale yellow flame of considerable density."

He then proceeds to demonstrate the principles which led to the safety-lamp; and, in introducing the subject, he says: "Flame is gaseous matter heated so highly as to be luminous, and that to a degree of temperature beyond the white heat of solid bodies, as is shown by the circumstance that flame not luminous will communicate this degree of heat. This is proved by the simple experiment of holding a fine wire of platinum about 1-20th of an inch from the exterior of the middle of the flame of a spirit-lamp, and concealing the flame by an opaque body. The wire will become white hot in a space where there is no visible light." Again, towards the end of the paper, he sums up his ideas on the luminosity of flames as follows:—

The circumstances mentioned in this paper, combined with those noticed in the paper on flame printed in Mr. Brande's *Journal of Science and the Arts*, explain the nature of the limit of flames, and their form. When in flames pure gaseous matter is burnt, the light is extremely feeble. The density of a common flame is proportional to the quantity of solid charcoal first deposited and afterwards burnt. The form of the flame is conical, because the greatest heat is in the centre of the explosive mixture. In looking steadfastly at the flame, the part where the combustible matter is volatilized is seen; and it appears dark contrasted with the part in which it begins to burn—that is, where it is so mixed with air as to become explosive. The heat diminishes towards the top of the flame, because in this part the quantity of oxygen is least. When the wick increases to a considerable size from collecting charcoal, it cools the flame by radiation, and prevents a proper quantity of air from mixing with its central part. In consequence, the charcoal thrown off from the top of the flame is only red hot, and the greater part of it escapes unconsumed. The intensity of the light of flames in the atmosphere is increased by condensation and diminished by rarefaction apparently in a higher ratio than their heat. More particles capable of emitting light exist in the denser atmospheres; and yet most of these particles, in becoming capable of emitting light, absorb heat, which could not be the case in a condensation of a pure supporting medium.

Let us now, said the lecturer, collect the theories enunciated in this masterly work, and see to what point it has carried our theory of flame and its luminosity:—

(1) The light emitted by coal gas is due to the decomposition of a part of the gas towards the interior of the flame where the air is in smallest quantity, and the deposition of solid carbon, which, first by its ignition and afterwards by its combustion, increases to a high degree the intensity of the light.

(2) The point of the inner blue flame of a blowpipe where the heat is greatest, is the point where the whole of the charcoal is burnt in its gaseous combinations without previous deposition.

(3) When pure gaseous matter is burnt in flames, the light is extremely feeble.

Taking these enunciations as they stand, there is little to wonder at that no marked opposition was raised to them for upwards of 50 years, and that, when the opposition came, it should have strengthened rather than weakened the edifice erected by the master-hand.

Professor Lewes then went on to say that the attention bestowed upon the subject of flame and the causes of its luminosity was small indeed during the next 35 years; and very little was done beyond some work by Berzelius, about the year 1820, upon the structure of flame, and a paper by Waldie, published in the *Philosophical Magazine* for 1838. The experimental portion of this, however, was mostly done in 1833, by Kemp, who showed what might be termed the phenomenon of reciprocal combustion—*i.e.*, that, the terms "combustible" and "supporter of combustion," being relative, it was as easy to burn a jet of oxygen in an atmosphere of hydrogen, as to do the more ordinary thing of burning hydrogen in oxygen. The general theory put forward first by Berzelius, as to the structure of flame, and which exists to the present time, would be best given in his own words:—

If we attentively consider the flame of a candle, we may remark several unequal divisions of it, of which four may be distinguished, We see at its base a small part of a dark blue colour, which becomes thinner as it gets farther from the wick, and disappears entirely when the external surface of the flame ascends perpendicularly. In the middle of the flame is a dark place seen through its brilliant covering. This space encloses the gases which issue from the wick, which, not yet being in contact with the air, cannot undergo combustion. Round this space is the brilliant part of the flame properly so called; and, lastly, beyond this we may perceive, by attentive inspection, the outer covering of all, slightly luminous, and whose greater thickness corresponds with the summit of the brilliant flame. It is in this outer part that the combustion of gases is completed, and the heat the most intense.

Important researches were made upon the chemical changes taking place in luminous and other flames during the fifties; and these would, Professor Lewes said, be considered later. In 1861, Dr. O. Kerston, published in the *Journal für Practische Chemie*, a paper in which he challenged a theory started by Graham-Otto some years before, that the carbon particles which give luminosity to a flame of gaseous hydrocarbons are liberated by the greater affinity of the oxygen for the hydrogen of the molecule, which burns first and so sets the carbon free. He showed that, by exploding ethylene with a limited quantity of oxygen or electrolytic gas, oxides of carbon are formed, and hydrogen, not carbon, is liberated. From this he reasoned that, in a flame, preferential combustion of carbon and not of hydrogen is an important factor.

All observations, however, said the lecturer, in conclusion, show that any theory of "preferential combustion," be it of hydrogen or of carbon, are totally apart from the causes which give rise to the liberation of the all-important carbon particles in the flame. An idea seems to exist that certain parts of a complex molecule can be eaten away by other bodies which have an affinity for it; but this is a manifest absurdity. In a hydrocarbon molecule or particle, neither hydrogen nor carbon exists as such; and before the affinities of these elements come into play, the complex molecule must be broken into its constituents. Sir Humphry Davy's original statement is therefore the true solution: "If the temperature of a flame is not sufficient to decompose the hydrocarbon into its elements, and thus deposit carbon, the hydrocarbon burns as a whole, and with a non-luminous flame.'

*Sir Humphry Davy adds as a foot-note to this statement: Since this paper has been written, I have found that phosphoric acid volatilizes slowly at a strong red heat. But, under moderate pressure, it bears a white heat; and in a flame so intense as that of phosphorus, the elastic force must produce the effect of compression.

Mr. Adolphe Crosbie, Managing Director of Adolphe Crosbie, Limited, of Wolverhampton, has just been elected a town councillor of that borough.

A NEW DISTRIBUTING STATION OF THE GASLIGHT AND COKE COMPANY.

A fine example of the engineering work that grows out of gas distribution upon a large scale is furnished by the new Stoke Newington valve-house of The Gaslight and Coke Company, which has just been completed to the designs of Mr. G. F. L. Foulger, the head of the Company's Distribution Department. The house is at the corner of Fairy Street, Stoke Newington Common; and the station is now the last outpost, in this district of North-East London, of the high-pressure service from Beckton and Bromley. Previously, the whole of the immense area stretching from Hackney Marshes to Highgate was supplied from one valve-house at London Fields. But the enormous growth of population concentrated here had rendered it necessary to carry the trunk main farther into the heart of the new residential quarter; and this has now been done to the point named. Here is the division-line between the upland region lying west of Stamford Hill and the flats reaching to the River Lea; and by bringing a 36-inch high-pressure main from London Fields to Fairy Street—a distance of two miles—a desirable fresh connection has been effected with a 30-inch and two 18-inch district mains running northward, and with other large district mains going eastward, these districts being separately valved. This was the locality of the lowest pressures for both systems; and the new station has converted it into one of the strongest centres of distribution. It should be stated that the district in question takes the whole of the output of the Bromley manufacturing station, and an additional supply from Beckton. At Fairy Street the reduction from the trunk-main pressure to that required for the district mains (which, at its lowest, is more than double what is required for district purposes) is effected by means of two of Parkinson's double-cone governors, one of 36 inches for the northern, and one of 24 inches for the eastern systems. These are handsome specimens of workmanship; and it is needless to say how absolutely steadily they operate under peculiarly trying conditions—the trunk-main pressure being subject to sudden and heavy variations, according to the pumping requirements of the different stations dependent upon this source of supply. The outlet pressures remain perfectly steady, as indicated by the registers attached. The governors are fitted with polished columns and ornamental girders. The valves attached to the governors—comprising inlet, outlet, and bye-pass—are by Donkin; and they are so fitted as to be easily worked by one man. The whole of the connections are simple and strong, without superfluous complications of any kind. We understand that the work of connecting up and equipping the new distributing station has been done within the time allotted, and for the price estimated by Mr. Foulger. Messrs. John Aird and Sons were the contractors for the main laying. It is worthy of placing on record, in view of the disclosures that have recently aroused public attention respecting the hours of duty of railway signalmen, that district valve men employed by The Gaslight and Coke Company constitute a distinct class in the Company's service, the conditions of which render it a desirable employment for steady, reliable men. They work eight-hour shifts, and are never alone in the governor-house; the man in charge being always accompanied by a learner. All the stations are in telegraphic connection with the Goswell Road head-quarters, where relief men are kept, with a view to meeting any emergencies.

Weights and Measures.—There has lately been issued by the Board of Trade a report on their proceedings and business under the Weights and Measures Acts, 1878 and 1889. It states that the results of the examinations and comparisons of the parliamentary copies of the Imperial standards show that no measurable change has taken place in the length of the standard of measure. The Imperial standard pound weight appears, however, by comparison with the parliamentary copies, to have decreased in weight since it was restored and legalized by the Standards Act of 1855. The amount of diminution will not be appreciable in trade, and probably arose before the year 1872; but the Board of Trade are taking into consideration the question of restoring this standard in the manner provided by section 6 of the Act of 1878. It is further stated that, since the passing of the Act of 1889, the Board have caused local inquiries to be made by their Superintendent of Weights and Measures (Mr. H. J. Chaney) with respect to the administration of the law relating to weights and measures in certain districts named. In most of the places visited, it has been found that the suggestions subsequently made by the Department for the improvement of the offices of the inspectors, or of the instrumental equipments, or as to the local administration of the law, were willingly carried out. In some districts, particularly in the smaller boroughs, there has, however, been reluctance to carry out the requirements of the Acts, owing to expense. In a few places, they had either been entirely disregarded by the local authorities, or the administration had grown so feeble as to afford practically no protection whatever to the purchasing public or to traders. With regard to the testing of photometers, since July 31, 1891, verifications of these instruments have been made for 16 gas companies and 36 local authorities; among the latter being the City of London,

ON THE USE OF OXYGEN IN THE PURIFICATION OF COAL GAS.

A Paper read by Mr. Harrison Veevers, of Dukinfield, before the Manchester District Institution of Gas Engineers, Saturday, Nov. 26, 1892.

I have for a long time been under the impression that the methods of removing the comparatively small quantity of sulphur from coal gas are on too large a scale, and that they are carried out at too great an expense in proportion to the amount of that impurity. The area of ground covered by the purifier-house, and the costly building and apparatus required, seemed excessive. The other impurities, such as tar and ammonia, do not need any such area or elaborate plant for their abstraction; and some time ago, in conjunction with two gentlemen who held similar views, I endeavoured to make sulphur removal simpler and less expensive. We erected a washer-scrubber, similar to the well-known appliance used for removing ammonia, and passed through it gas mixed with a proportion of sulphurous acid gas. But, without entering into details, it proved a failure, although it was successful as a laboratory experiment. I merely mention this to show that, when we required new purifiers, I was prepared to adopt any plan which would lessen the first annual cost. I was attracted by the results of the use of oxygen at Ramsgate and Shrewsbury.

For many years the purifiers at the works under my management were a source of anxiety and expense. Whether through inherent weakness in their supports, or owing to the subsidence of the ground in consequence of colliery operations, the plates of the boxes were continually fracturing—often during the night. Not unfrequently the hydraulic joint would leak, and gas would escape in not inconsiderable quantities. I may here incidentally remark that, though these works have sunk bodily about 12 feet since their erection, no other part of the apparatus has suffered, with the exception that, about a dozen years ago, one of the holders had its columns thrown slightly out of the perpendicular, and the station meter has once required adjustment. This, however, is by the way. Not long ago the danger of explosion by gas escaping from such treacherous purifiers became so serious that I was reluctantly compelled to warn the Board that I could not venture to hold myself responsible for the safety of the works. I therefore advised that a new building and purifiers should be erected; and this was agreed to.

Desirous of adopting the most recent and most successful of improvements in this department of the manufacture of gas, I considered some of the plans for the admixture of air, carburetted or otherwise; but the schemes were rejected—the dislike to admitting the inert gas nitrogen being the principal reason. The oxygen only was required, and not its useless companion nitrogen, which is useful as a diluent for animal and plant life, but worse than useless for combustion, and the more so from the fact that one part of oxygen admitted would have four of nitrogen accompanying it.

The good results following the adoption of the oxygen process by Mr. W. A. Valon, Assoc.M.Inst.C.E., the ex-President of the Incorporated Gas Institute, attracted my attention; and, learning that Mr. Belton had the process in work at Shrewsbury, I visited these works by permission, and was satisfied that it was a success. Mr. Belton kindly gave me full particulars of the working, which convinced me there was not only economy in the expenses of labour and of cannel, but in the cost of the purifiers and the house. I found that, to provide for the requirements of the Dukinfield works, for (say) twenty years ahead, six 18 feet square purifiers would be needed, which, with the house, would cost at least £6000; but, by the use of oxygen, only four purifiers would suffice, at a cost, including the oxygen apparatus, of £4400. The old purifiers were four in number, and 16 feet square.

The main reason for the use of oxygen is that the oxide of iron is revivified in the purifiers, without being exposed to the oxygen of the atmosphere, with its consequent expense of labour in emptying and filling the boxes, and turning over the oxide to get a thorough re-oxidation. But, irrespective of this, there was a more serious matter to be considered. Every time a box was opened, there would be a loss of at least 1000 cubic feet of gas; and, when replaced, an equal quantity of air would either be included or have to be expelled by a similar quantity of gas. In winter, a purifier frequently required changing ten times a week; entailing a loss of either 20,000 cubic feet of gas, or the inclusion of a quantity of air which, by diminishing the illuminating power, had to be rectified by the use of a greater quantity of expensive cannel. After mature consideration, I advised the adoption of the system patented by the Brin Oxygen Company; and the Board consented.

A brief description of this method of obtaining a separation and imprisonment of oxygen from the atmosphere may not be superfluous. Air is drawn through a small purifier containing freshly burnt lime, which desiccates the air, and also removes any carbonic acid gas; and, to make assurance still more sure, it then passes through a vessel in which there is caustic soda. Being thus in an almost dry state, the air is forced through steel or iron retorts, set vertically, which contain caustic baryta in a spongy condition, and are heated to a faint red heat (about 1350° Fahr.). The baryta, when heated and under pressure, has the property of absorbing the oxygen and rejecting the nitrogen, which escapes by means of a valve. It gives off

this oxygen when a vacuum is created. This work of alternately arresting and removing the oxygen is performed in a most admirable manner by an automatic machine, which may be worked by steam or else by a gas-engine. This machine can be regulated at will to suit the action of the baryta. The pressure in the retorts is 10 lbs.; and the vacuum, 13 lbs. After being abstracted from the retorts, the oxygen is forced into a small holder on the Gadd and Mason principle, and thence conveyed to a meter regulated by a valve to admit 1 per cent. of the quantity of gas made. The holder contains an amount equal to one day's demand; but I should advise one of double that capacity, or even larger. The proportion of oxygen in the holder is about 90 per cent.

The removal of the old purifiers and the erection of four more on the same site, without stopping the supply of gas to the town, was no easy matter. On the 22nd of June last, two of the new purifiers were fixed, with temporary connections, but without the centre-valve; and oxygen to the amount of 1 per cent. was admitted at the inlet of the exhauster. These boxes were charged with oxide already somewhat spent; and it was an anxious time for us while we were speculating as to whether or not they would last until the completion of the remaining boxes and centre-valve. Day by day the gas was tested; but with no trace in the last purifier of the presence of sulphuretted hydrogen. Once only, for a short time, were the covers removed, to fix the inlet and outlet pipes to the centre-valve. On the 20th of October, a box was emptied through which 13,635,000 cubic feet of gas had passed; and the two new ones were filled with some partly-spent oxide, but how far spent was not previously ascertained. These speedily became foul; and some sulphuretted hydrogen passed before a fresh supply could be procured. The oxide from the first box showed, on analysis, the presence of upwards of 65 per cent. of sulphur; thus proving practically to my satisfaction that the oxide could be revivified in the boxes without any of the labour of removing and replacing it. Unfortunately, the town is not provided with a bar photometer; so that the effect of the process on the luminosity of the gas cannot be given. But by the jet photometer, and by visual appearance, the gas now supplied gives a whiter flame. I do not claim that the oxygen is directly the cause of this better light; but it is indirectly, owing to the covers of the purifiers not being removed so often—thereby preventing the presence of nitrogen.

The process has been in use so short a time that I cannot give, in figures, what the financial economy may be; but it may claim to have the following advantages:—

(1) Revivifying the oxide saves labour.

(2) It also excludes the admission of nitrogen; and, in consequence of this, less cannel is required to produce the necessary illuminating power.

(3) Increased value of the spent oxide. It is impossible to get the strength of the spent oxide to 65 per cent. without more frequent revivifying in the air, at a greater expenditure in labour than the value of the extra 15 per cent. of the sulphur.

(4) As the oxide abstracts more sulphur, less oxide is required annually.

(5) Greater uniformity in the illuminating power of the gas, particularly in small or medium-sized works.

AN ACCOUNT OF A RECENT EXPLOSION IN A TAR-WELL.

A Paper read by Mr. W. R. Chester, of Nottingham, before the Manchester District Institution of Gas Engineers, Saturday, Nov. 26, 1892.

I have been asked to lay before you some of the circumstances in connection with a mysterious explosion which recently occurred in a tar-well at one of the gas-works of the Nottingham Corporation. Unfortunately, explosions in gas-works are not of infrequent occurrence. They are, however, generally due to gas itself; and they can, as a rule, be easily traced to some simple yet well-defined cause, which upon investigation leaves little doubt either as to the composition of the explosive mixture, or how the same came to be ignited. In the explosion now under consideration, both the composition of the mixture and the mode of ignition are involved in mystery; and it is partly on this account, and because of the rarity of such an explosion, that I have considered it of sufficient importance to receive the consideration of this Institution.

The tar-well is constructed below ground, at one end of a large block of buildings containing the engine-house and two sets of purifiers in the central portion, with a revivifying shed at each end. Above these sheds are store-rooms; and below, at one end, there is the tar-well, and at the other end the liquor-well of similar dimensions. The tar and liquor are divided in a separator, and each passes direct to its respective tank. The tar-well is 68 ft. 11 in. long by 29 ft. 8 in. wide and 9 ft. 2 in. deep, having a cubic capacity of 18,741 feet, or about 117,000 gallons. It is constructed of brickwork in cement, and covered with arches supported on cross walls; the floor above being finished in York flags. The store-room floor is carried on cast-iron columns 16 ft. 9 in. high, resting on piers built in the tanks, and is of fireproof construction. There were eight manhole openings into the tank, each about 2 feet square, and each somewhat imperfectly covered with timber. The tank was full, to the springing of the arches, with tar, having a covering of perhaps 3 or 4 inches of liquor on the top; and there was therefore only the space afforded by the crowns of the arches for a gaseous explosive mixture to accumulate in. Two longitudinal intersecting arches formed a communication with the whole of the spaces above the tar. There were two inlet-pipes (we will call them A and B), which entered above the level of the tar, and a suction-pipe, dipping, of course, to the bottom of the well. The inlet-pipe A, 8 inches in diameter, is from the separator; and the other, B, also 8 inches in diameter, is a drain-pipe leading to a syphon 120 feet away. The end of the drain-pipe is open, and the tar, which accumulates in a syphon on the inlet of the exhausters, is pumped into it at stated periods. The open end is about 10 feet from a boiler furnace. On the floor above the tank was some oxide of iron in process of revivification; and at the time of the explosion there was no known light nearer than about 50 feet away.

The explosion took place at seven o'clock on the morning of the 10th of July this year—a Sunday, when all the men were away, with the exception of about half-a-dozen who were retained for feeding furnaces, &c. The nearest man at the time of the explosion was the boiler furnace man, who was about 120 feet away. But another man had passed through the shed only five minutes before; and he noticed nothing unusual which would in any way account for the accident. The explosion was sharp and sudden; and it was followed by rumbling sounds heard some distance away. No fire followed; and only a little dust was perceptible. The effect of the explosion was to burst up the whole of the arches and floor covering the tank, and to cause them to tumble into the tar. The floor above was lifted, and the necks of several of the columns were broken; but only one column fell, and the floor remained, though in a somewhat unstable condition. No one was injured, and no further damage was done, though the outer wall appeared to have been lifted bodily upwards, commencing at the top of a stone string, course, and was afterwards set down again, projecting 1¼ inches outwards beyond its proper position.

As to the cause of the explosion, there are several possible explanations; but nothing of an absolutely conclusive character has yet been discovered. Wilful intent or malice may be dismissed without a second consideration, as there is no evidence to indicate, or even suggest, this as a possible cause.

The combustible of the explosive mixture may have been gas, or it may have consisted of some volatile hydrocarbon vapour from the tar. If the latter, how came it there? In the first place, the temperature of the tar was not higher than 70° Fahr.; while the first drop of benzol, its most volatile product, cannot be obtained at a lower temperature than about 80° C., or 176° Fahr., which is more than 100° Fahr. higher than that at which the tar stood in the well. Secondly, it must be remembered that there was a body of liquor about 3 inches thick floating over the surface of the tar; thus cutting it off entirely from contact with the atmosphere, and forming, one would suppose, a sufficient barrier to prevent absorption. I do not, therefore, think the combustible in the explosive mixture can have been a tarry vapour. If the combustible was gas, the question again arises: How did it get there? On examination of the walls after the tank had been emptied, they were all found to be sound, and free from crevices; and no leaks from the neighbouring pipes or vessels could be discovered. Supposing a leak to have existed in the adjoining purifier-house, it is impossible to conceive that the gas could have descended through the manholes into the tank below, when it had free exit in every other direction. One other theory remains to account for its presence; and this appears to be the most likely explanation of all. Was the gas carried into the tank by mechanical admixture with the tar, and, on settlement, afterwards set free? Some experiments I have recently been making lead me to this conclusion.

At these works it has been customary to scrub with large volumes of liquor; and when investigating a few weeks ago, I found the liquor to be passing the scrubbers at the rate of 1 volume for every 137 volumes of gas, which is equivalent to about 475 gallons per ton of coal carbonized. From the liquor in the seal-box, close up to the scrubbers, it was noticed that numerous bubbles of gas were constantly rising to the surface; and a simple test showed that these were coal gas, which was escaping at the rate of 390 cubic feet per square foot of surface per 24 hours. A similar test applied to the separator, some distance away, gave an escape of 4 cubic feet of gas per square foot of surface per 24 hours. A third test applied to the liquor in the well, about 3 feet away from the inlet-pipe, gave an escape of rather more than 1 cubic foot of gas per square foot of surface per 24 hours. A fourth test at the opposite end of the well showed no escape of gas; thus proving that all the gas carried into the well by the liquor in a state of mechanical suspension had afterwards been set at liberty. Now, as the depth of the well is about 10 feet, and assuming it to be half full, and also assuming that the liberation of gas is going on at the rate of 1 cubic foot per square foot of surface per 24 hours over half the area of the well, it will be seen that a violent explosive mixture, in the proportions of 1 volume of gas to 10 volumes of air, may at all times be anticipated to exist.

At the time of the explosion, the well was nearly nine-tenths full of tar, and there was therefore not more space than about 1½ feet in depth for the explosive mixture to fill; and if it

were composed of 1 volume of gas to 8 volumes of air, it would only require an escape of ⅛ cubic foot of gas per foot of area per 24 hours to form a disastrous explosive mixture. In the separator, both tar and liquor mingle when first entering it, and it is only fair to suppose that the tar will carry off, in a state of mechanical suspension, at least a portion of the gas brought to it by the liquor flowing from the scrubbers, and that it will afterwards set it free when at rest in the well. This I consider to be the most probable explanation of the presence of the explosive mixture.

We have still to account for the ignition. The explosion took place in broad daylight. There are three possible explanations of the mode of ignition: (1) It may have been due to the tossing of a lighted match, or the throwing of the ashes of a tobacco-pipe, through one of the openings in the wall, by some careless and thoughtless passer-by. But against the probability of this explanation there is the fact that a stringent regulation against smoking is enforced at all the works; and, moreover, if ignition were due to this cause, it would probably have immediately followed after the light, and thus involved the guilty party in the wreck. (2) Ignition might have been due to the spontaneous combustionof spent oxide lying on the floor above, in process of revivification. But against this there is the fact that a man passed through the shed only five minutes beforehand; and he could not have failed to notice fire, if it had existed. (3) Ignition may have been caused by the firing of gas in the drain-pipe B, which has its outlet near a boiler furnace, though 120 feet away from the well. If so, the fire must have run back along the pipe to the well, and thus ignited the explosive mixture therein contained. Against this, which I consider to be the most likely explanation of the ignition, we have the fact that the boiler man had not commenced to clinker out, and the end of the pipe was at least 10 feet away from the fire in the boiler furnace.

As gas engineers, we have to consider what are the practical lessons taught by such an explosion, and to determine what steps are necessary to be taken in order to render the recurrence of such explosions impossible. For my own guidance in the future, I have laid down the following rules:—

(1) The scrubbing plant should be of the highest efficiency, so that the ammonia purification may be effected with the smallest possible quantity of liquor.

(2) There should be a small receiver into which the liquor or tar should flow prior to entering the store-tank, in order to give an opportunity for the separation of gas held in mechanical suspension.

(3) All pipes entering the store-tanks should be carried to within a few inches of the bottom of the well, so as always to be sealed.

(4) All manholes should be made of cast-iron frames having sealed covers.

(5) The manhole covers must not be removed except during daylight; and no artificial light is on any account to be brought near when the covers are off.

If such practice is adhered to, I have every confidence that, in the future, we shall have no reason to anticipate explosions in either tar or liquor wells.

REGISTER OF PATENTS.

Gas-Engines.—Ridealgh, C., of Sunderland. No. 19,811; Nov. 16, 1891.

This invention, relating to gas and petroleum engines, is designed to obtain "economy and the hygienic working, with an impulse every revolution when working to full power."

The piston-crank and connecting-rod work in a sealed chamber attached to the cylinder casing, whereby the air contained in the chamber is affected by the motion of the piston. The piston is connected to the crank by a connecting-rod in the usual way, and is opened to the sealed chamber. It is made long with packing-rings at both ends, wherein one end of the piston acts as an air and gas pump, and the other end receives the force of the explosion. The fluid charge to be exploded or ignited, or part thereof, is admitted and exhausted into the working cylinder by ports so situated in the barrel of the cylinder as to be uncovered by the piston when it approaches the end of its acting stroke, and covered again soon after the piston has commenced its return stroke.

According to one arrangement, the cylinder is closed at one end by a suitable cover, and at the other end opens into a casing, within which revolves a crank that works in suitable bearings in one or both sides of a suitable casing. The piston is connected to the crank by a connecting-rod, so as to convert the reciprocatory motion into a rotary motion. The first-named end of the cylinder (the outer end) is that in which the combustible mixture is compressed and ignited; the opposite end—namely, that opening into the crank casing—acts as a pump supplying the air from a valve in the casing. Through the wall of the pump casing, there is a hole in a suitable position, the size of which will vary in shape and form, opening outwards. Over the flexible cover and valve to this is placed a gas chamber, with a port-way leading to the working barrel of the cylinder; and to the gas chamber is fixed a gas-supply valve, which is acted upon by a hit-and-miss pendulum governor, which receives its motion by the pulsation of the flexible partition. The charge is fired by a heated tube, in the base of which is a double-beat valve operated by a tappet screwed and adjusted in the piston.

Feeding Fuel to Gas-Producers for the Generation of Combustible Gas.—Hargreaves, J., of Farnworth-in-Widnes, Lancs. No. 20,573; Nov. 26, 1891.

Hitherto, in the production of producer gas or water gas, says the patentee, it has been the practice to feed in the solid fuel from above, with the result that the charge in the producer was with difficulty kept in the required condition for the free and uniform and satisfactory evolution of combustible gas. Many expedients have been employed to overcome this difficulty—such as feeding the fuel in a finely-divided condition all over the upper surface of the charge, and the employment of mechanical stirrers or moving bottoms.

In order to avoid the formation of large solid blocks of fuel in the producer, and thus obtain the desired homogeneous evolutions of gas. the patentee proposes to feed the fuel in from the bottom upwards, or in an upward direction, at a point preferably above and in front of the nozzles through which air and steam or air only are supplied to support combustion. This is to be done in such a manner that the fuel piles itself up into the body of the producer; and the piled mass of coke serves to more fully saturate the gas with carbonic oxide. In combination with this system of feeding solid fuel into producers, the solid fuel and air fed into the producer are measured, so as to obtain the desired quality of evolved gas. Any suitable feed and measuring appliances for the purpose may be used.

Gas-Engines.—Lanchester, F. W., of Bedford Row, W.C. No. 21,406; Dec. 8, 1891.

In carrying out the part of this invention which is more particularly applicable to double-cylinder gas-engines, the patentee so arranges to connect the two cylinders that the pressure of compression in those cylinders acts alternately on the automatic exhaust-valve of each cylinder, in such a manner that one cylinder is caused to compress its charge while the other is exhausting. When the two pistons are connected to the crank-pins, which are in (or nearly in) line with each other, the two cylinders are connected by a passage, controlled by opposing lift-valves; and these valves open into their respective cylinders, and close with the compression. The valves are so connected by their stems that, when one is forced to its seat, the other is necessarily forced from its seat; so that one valve is closed and one open at any particular instant. The valve stems pass through a suitable sleeve, which divides the passage or chamber between the cylinders into two parts—the sleeve being arranged so as to be sufficiently pressure tight, with or without a stuffing gland. Each of the parts into which the passage or chamber is divided connects with an exhaust-valve casing, so that pressure from that part actuates a piston in the casing and opens the exhaust-valve. Each of the two ports or chambers connects to the exhaust-valve casing of the other cylinder.

Premissing that an engine of this type is fitted with automatic gas and air inlet valves, as well as automatic exhaust-valves, the action of the engine is as follows: Assuming both pistons to be full out, and to have taken in a charge of gas and air into their respective cylinders, on the return stroke one of the connected valves is forced to its seat, and the other valve is held open. At first, both pistons compress the charge; but the pressure from the cylinder whose connected valve is open finds its way to the exhaust-valve piston of the other cylinder, and this pressure opens the exhaust-valve. The cylinder in which the connected valve is at first closed therefore discharges its contents into the exhaust-pipe. But this at once allows the pressure in that cylinder to fall; and the pressure of compression in the other cylinder shuts its valve and opens the opposing valve. Although on the exhausting stroke, the exhausting cylinder now connects with the exhaust-valve of the cylinder in which compression is proceeding, the pressure of compression on the top of the exhaust-valve in that cylinder is too considerable to allow the feeble back-pressure of the exhausting stroke to open it. Compression accordingly proceeds in one cylinder till the end of the stroke is attained, when the compressed mixture in the explosion or combustion space is ignited in any usual manner, and an impulse is given on the out-stroke. The connected valve in that cylinder is held down by the working pressure; but at the end of the stroke, the burned gases preferably discharge to atmospheric pressure through a port overrun by the piston; and the pressure of compression from the other cylinder opens the exhaust-valve of the cylinder in which the working stroke has just been completed, and so that cylinder in turn exhausts and the other compresses its charge preparatory to ignition. In this manner, the exhaust-valve of one cylinder is actuated by the compression in the adjoining cylinder.

Another part of the invention relates to the governing of gas-engines—especially applicable to engines adopted for electric lighting. It consists in opening a valve of regulated discharge area into the cylinder to dilute the charge. But the air is admitted by a separate passage, so that it does not interfere with the richness of the mixture in the ignition port, through which the inflammable charge is drawn. To carry this part of the invention into effect, a port is arranged to open into the compression space away or separate from the usual gas and air admission port; and this port is controlled by a lift-valve, opening inwards and kept to its seat by a spring of regulated tension. The seat is comparatively small in area; but the valve is expanded within to a considerable diameter, so as to nearly fill a cylindrical space, opening by the port to the compression space. So long as the engine rotates at its normal speed, the suction reduces the pressure within to a certain point; but if the speed increase, the pressure falls, and so the air-valve is lifted from its seat. Immediately this occurs, the air entering presses upon the enlarged part, and lifts the valve to its limit. Excess of speed thus at once dilutes the charge to a predetermined degree, and the power of the explosion is reduced without causing any missed ignitions.

Another part of the invention relates to the means of quieting the noise caused by the air suction; and this is performed by drawing the air supply from a closed chamber, containing water or oil. The air may be taken to the engine by a pipe opening into the upper part of this chamber clear of the oil; but the air is admitted from the atmosphere to the chamber by a pipe or (preferably) a number of pipes pointing downwards to the liquid, and terminating close to the liquid, or slightly under its surface. The sound wave is thus broken up; and

the energy is expended in agitating the liquid, instead of causing noise. The air-chamber is placed preferably under or within the engine-bed; and is so connected that the waste oil from the engine drains into it to supply the oil, when oil is used. The air-chamber is provided with an aperture and tap to take off the oil and maintain it at a nearly constant level. The air-pipe from the chamber to the engine may be placed within another pipe, so directed that the air current strikes the liquid before entering the said pipe, and so reduces the sound.

Gas-Furnaces.—Newton, H. E.; communicated from R. N. Oakman, of Greenfield (Mass.). No. 21,634; Dec. 10, 1891.

This invention relates to a furnace adapted for heating pipes for welding the longitudinal seam, by the combustion of gas and air introduced and burned under pressure, in such manner that the flame shall pass twice (or in a double sheet) through the furnace, and over the pipe. It is also adapted to heating iron or steel in bars or blooms for forging or welding; and for heating the skelp from which the pipes are rolled by waste heat from the welding furnace, and utilizing the waste products for heating the air which is forced to the burners. The object aimed at is to provide for "more uniformly heating the pipe or material which is to be welded by the combustion of fuel gas and air under controlled pressure."

The furnace is constructed with an inwardly projecting and overhanging ledge or bridge containing the burner ports and burners; and also a reverberatory or arched crown is provided, by means of which the flame is deflected and made to fold upon itself as it passes out over the rolled-up tubes. It thus heats a number of tubes throughout their entire length, as it passes out through the escape flues or ports arranged under the projecting bridge. The rolled-up skelps ready for welding are introduced first under the overhanging bridge or arch, below which passes the return current of flame and hot products; and they are advanced successively to the hottest part of the furnace at the rear side, until ready to be drawn out and rolled in the usual manner.

Gas-Taps.—Phythian, A. T., of Manchester. No. 22,591; Dec. 28, 1891.

This invention consists in providing the plug of an ordinary gas-tap with an adjustable collar or nut, forming a stop (for arresting the rotation of the plug at any desired point when turned in one direction), which may be so adjusted as to prevent the gas being absolutely turned off, but give a "glimmer" of light of any desired size—the ordinary pin or stop serving to arrest the rotation of the plug for completely shutting off the gas when turned in the opposite direction. In this way, there is produced a gas-tap possessing the advantages of an ordinary tap and those of a "glimmer" tap, and dispensing with the necessity for separate taps for completely shutting off the gas and for simply diminishing the supply so as to give a "glimmer" as heretofore.

The pin or stud above mentioned is affixed to the plug in the usual manner; and it has for its abutment an ordinary shoulder on the tap body, while the collar or nut already alluded to is adapted to screw on to the plug, and is provided with a sloping projection corresponding to a sloping face or abutment on the body of the tap. By screwing or unscrewing the collar or nut on the plug, the two sloping faces are caused to meet earlier or later; and so the extent to which the gas is to be turned off or on may be effectually determined. By turning the plug in the direction of the ordinary shoulder, the supply of gas is completely turned off; but on turning it in the opposite direction, the rotation of the plug is arrested before it reaches the point of cut-off by the sloping projection on the adjustable collar coming against the sloping face on the tap body, and so preventing the gas being completely cut off.

Ignition-Tubes for Gas-Engines.—Whittaker, G., of Manchester. No. 16,986; Sept. 23, 1892.

A gas-engine ignition-tube constructed according to this invention consists of a bulbous forging or casting, the interior of which communicates with the interior of the cylinder of the engine. It is heated by an annular burner surrounding the bulbous part of the tube; and when in use, the tube is enclosed within a chimney, by preference lined with asbestos. The chimney and the burner at the base of the chimney are adjustably arranged, so that the heat from the burner may be applied at a higher or lower part of the tube, as may be necessary.

Manufacturing Gas.—Bidelman, R. M., of Adrian (Mich.), U.S.A. No. 17,262; Sept. 27, 1892.

This invention (says the patentee) is "based upon the discovery that a fixed gas can be obtained by forcing an aëriform fluid under pressure through a liquid hydrocarbon, from which the constituent parts furnishing condensable vapours have been first removed; the air current, on its passage through the hydrocarbon, being broken up both below and above the level of the liquid into minute streams by the agency of closely-packed absorbent solid material."

After giving a general description of one form of plant useful for the purpose, the specification continues: The liquid hydrocarbon employed is a distillate of a petroleum oil obtained from oil-wells in the vicinity of Lima, State of Ohio, and known as Lima oil. It has a specific gravity of about ·698. It contains substantially none of the light gravity gasoline and other kindred constituents, which, in ordinary carburetting operations, furnish vapours condensable under ordinary temperatures and conditions of pressure; the light gravity products having been removed or driven off during the first stages of the process of producing the distillate. By experiment, it has been found that such distillate contains in solution hydrocarbons which may be taken up and removed as fixed gases, by passing through a current of air under pressure, so as to constitute with the air "a mixture furnishing a heating gas which may be stored for use in holders, and conducted through supply mains to great distances, without appreciable condensation under ordinary conditions, and, indeed, without as much condensation as ordinary coal gas under like circumstances."

Analyses of the gas produced show that it contains, intermixed with the air, a percentage of about three parts of fixed hydrocarbon gases, of which marsh gas is the principal constituent; the other constituents being olefiant and heavy hydrocarbon gases. Thus, one analysis gave as the constituent parts of the gas, the following percentages:—

Marsh gas	1·94
Olefiant gas and other heavy hydrocarbons	1·27
Nitrogen	77·63
Oxygen	19·16

The gas is of high calorific power, heating wrought iron rapidly to bright redness, when inserted in the flame, without the addition of any air blast; and, when introduced into a muffle furnace with the addition of an air blast, being capable of producing an intense white heat sufficient to fuse fire-brick and melt copper or other metal. Another use to which the gas may be applied, is to furnish the flame for heating the mantles of illuminating burners. In this way, the gas has been used continuously for months, "in a permanent street-main supplying Welsbach burners, to a distance of over 2000 feet from the gasholder, with practically no condensation, although the main makes a number of turns at right-angles to each other along the line, and at points dips a number of feet below grade."

APPLICATIONS FOR LETTERS PATENT.

20,645.—Simmance, J. F., "Warming apartments with hot water." Nov. 15.

20,683.—Pinkney, C. W., "Gas-engines." Nov. 15.

20,690.—Lake, H. H., "Valve-operating mechanism for gas or water pipes and the like." A communication from J. W. Ogden. Nov. 15.

20,709.—Vestraut, L. Van, and Graham, M., "Charging inclined gas-retorts." Nov. 16.

20,710.—Vestraut, L. Van, "Charging inclined gas-retorts." Nov. 16.

20,721.—Cowan, W., "Automatically varying the load and pressure of gas-governors and in means or apparatus employed therefor." Nov. 16.

20,746.—Muirhead, S., "Gas-producer." Nov. 16.

20,783.—Ennis, T. F. and G. F. M., "Manufacture of coal gas." Nov. 16.

20,802-3.—Andrew, H. H., and Bellamy, A. R., "Gas, oil, and similar motor engines." Nov. 17.

20,860.—Love, J., "Apparatus for carburetting or enriching gas or air." Nov. 17.

20,869.—Lewes, V. B., "Manufacture or production of gas." Nov. 17.

20,953.—Senator, S., "Controlling or regulating the supply of gas to burners." Nov. 18.

20,999.—Walker, R. C., "Gas-lighter." Nov. 19.

21,008.—Hall, J. H., "Producing illuminating gas." Nov. 19.

21,028.—Sutherland, W. S., "Gas-producers." Nov. 19.

21,043—Hambidge, H., "Gas-stove for heating, cooking, and drying." Nov. 19.

21,063.—Oates, J., "Automatically lighting gas-stoves and the like at predetermined times." Nov. 19.

CORRESPONDENCE.

[*We are not responsible for opinions expressed by correspondents.*]

The Six-Lift Holder at East Greenwich.

Sir,—The paragraph in this week's Journal relating to the new East Greenwich gasholder requires correction. It is represented as a five-lift holder with two lifts (or, say, two-fifths of its height) rising above the guide-framing; whereas it is a holder with six extremely shallow lifts. Consequently, only one-third of its height rises above the guide-framing; and as the ratio of the depth to the diameter of each lift is only 1 to 10 (the actual figures being 30 feet to 300 feet), two of these shallow lifts when cupped are only about equal to one ordinary lift. It, therefore, follows that, although it is, I believe, actually the first large gasholder that has had its framing shortened by two lifts, it is really no more than was done at Rotherhithe five years ago, when the system was applied to a three-lift holder with one lift free.

I give this explanation because I fear, in its absence, some enterprising manager may say: "If two lifts out of five can be safely left unsupported, why not two out of four, or even two out of three." I am anxious to prevent him being misled by incorrect information about the East Greenwich holder, and that if he ventures on such an experiment he shall do so on his own responsibility.

It is true that eleven years ago I expressed the opinion that a three-lift holder, with two lifts unsupported by guide-framing, might be constructed; but further consideration has led me to believe that to do so with a large holder would be both unwise and unsafe, because the side sheeting is not adapted to bear diagonal or racking stresses, which contention must hold good until it is proved that the wind or other force acting on a gasholder would not produce those stresses when the upper lifts are unsupported by guide-framing. Mr. Cripps has shown in his book that, with one lift free, the stresses on the sheeting are unimportant, but that they grow at a rapid and increasingly serious rate as the depth unsupported becomes greater; and Mr. Gadd (who first accepted my challenge to deal with this question, then went off on another point, and finally made the excuse that until Mr. Cripps did something or other he could say nothing about it) has, in my opinion, thereby practically admitted that, so far as he is concerned, it is unanswerable.

Nov. 25, 1892. George Livesey.

Purification.

Sir,—Perhaps Mr. C. C. Carpenter will excuse me asking one or two questions respecting his paper on "Purification," recently read before the Southern District Association of Gas Engineers and Managers, as there are a few points which strike one as being rather strange, and on which a little more information is desirable.

Among other things, we are told that "lime combines with sulphuretted hydrogen, but that the resultant compound is quite useless for

absorbing carbon disulphide." Has Mr. Carpenter any proofs to offer for this statement? Veley has shown, by actual experiment, that just the contrary is the case (*Journal of the Chemical Society*, July, 1885).

In the ordinary rotation system of purification, in which four boxes of lime and two of oxide of iron are worked in conjunction with an air supply, Mr. Carpenter recommends 1 per cent. of air to be introduced "into the fourth or third purifier in a rotation set." He states that this quantity of air has been found to bring about the desired reaction, by which the 40 to 50 grains of sulphur compounds per 100 cubic feet may be removed from crude gas. This air has to be forced through the fourth or third purifier, and to be admitted to a different purifier every time a box is changed. There is nothing in Mr. Carpenter's paper to show that there is the slightest advantage in this process over the simpler one of allowing the 1 per cent. of air to pass into the crude gas on the retort side of the exhauster. Certainly, the latter method will equally reduce the sulphur compounds other than sulphuretted hydrogen.

In the figures given by Mr. Carpenter, one point is clearly brought out—viz., that the lime box which is most active in the absorption of sulphuretted hydrogen is also the most active in taking up the carbon disulphide. But surely there is nothing surprising in this. Where else could one expect the carbon disulphide to be absorbed in such a rotation set of purifiers? There is no doubt that a lime box which is actively fixing sulphuretted hydrogen, and in which some little oxidation is also going on, is a very suitable box for absorbing the small amount of sulphur compounds present in crude gas. But there seems nothing to be gained by keeping the 1 per cent. of air out of the gas until the third lime box is reached. Nor is there anything extraordinary in the fact that, by this new process, one million cubic feet of gas, containing the small amount of 365 grains of sulphuretted hydrogen per 100 cubic feet, and 0·33 per cent. by volume of carbonic acid, can be purified by a superficial purifying area of 300 square feet.

In Mr. Carpenter's final summary of the chief points of his paper, he states that "this supply of air (1 per cent.) should be proportioned having regard to the removal of carbon disulphide, and *not* the sulphuretted hydrogen." Now, where does the proportion between the air and the carbon disulphide come in? The 1 per cent. of air contains seven or eight times as much oxygen by volume as there is carbon disulphide vapour in the gas at the inlet of the purifiers. This quantity of air appears nicely proportioned for breaking up 200 grains of sulphuretted hydrogen per 100 cubic feet. Can Mr. Carpenter offer any explanation as to how the oxygen of the 1 per cent. of air is required for, or has anything to do with, the removal of the 36 grains of carbon disulphide? It has never been suggested that the carbon disulphide is oxidized in any way. Mr. Carpenter himself mentions that it has been proposed to extract the carbon disulphide from the spent purifying material.

In the well-known reactions by which carbon disulphide is absorbed by more or less sulphided lime, no oxygen whatever is required; thus—

(1) $Ca\,S + CS_2 = Ca\,CS_3$
(2) $2Ca\,SH\,OH + CS_2 = Ca\,(OH)_2, Ca\,CS_3 + SH_2$

It would be interesting to know what amount of oxygen in the 1 per cent. of air is actually used up in the "fourth or third purifier," and how much goes forward into the oxide of iron boxes. It would also be equally instructive to learn how the oxygen is taken up at the Vauxhall works when the air is passed through the whole of the lime boxes, and what amount of oxygen is then found to be present at the inlet to the third purifier.

Rochdale, Nov. 24, 1892. THOS. STENHOUSE.

SIR,—In the JOURNAL for the 15th inst., I read with considerable interest Mr. C. C. Carpenter's paper on "Purification," more particularly the portion relating to the so-called "Beckton system," and the method of obtaining a reliable sulphide of calcium, for the elimination of the sulphur compounds. I have worked the above-mentioned system at Norwich for the past six years; and I have found, as did Mr. Carpenter, that it was impossible to manufacture a good sulphide of calcium without the admission of a suitable quantity of air, and at the point of requirement—viz., the inlet of the sulphide of calcium boxes. The sulphide, when newly made, used to work for a few days, and then suddenly become inactive in a most unaccountable manner. I then tried taking the whole of the material out of the box, and spreading it over the floor; allowing it to absorb air in sufficient quantity to raise the temperature of the material very considerably. On replacing, it worked very well for a lengthened period; but eventually it became again inactive, and also began to give off sulphur in large quantities, more especially in cold weather. It was this erratic behaviour of the sulphides that led me to adopt the apparatus I now have—viz., a Warner air-pump, to which is affixed a meter. With this arrangement, I force directly into the sulphide purifiers, during the sulphiding, about one-half per cent. of air; and, on the completion of the process, the percentage of air is reduced to a continuous quarter per cent. as long as the life of the box, which in my own case averages from ten to twelve months. This method is entirely satisfactory, and places the sulphur compounds entirely under control. In addition, to further ensure the continued chemical activity of the sulphide boxes, I employ a system of steam-pipes, heated by the exhaust steam from the tar and liquor pumps. This maintains a temperature of about 65° Fahr. in the sulphide house during the colder months of the year.

It is hopeless to expect a continuous activity of the sulphide of calcium boxes by the admission of air on the vacuum side of the exhauster, for the reason that the oxygen is almost entirely absorbed by its passage through the carbonic acid and sulphuretted hydrogen purifiers.

British Gas-Works, Norwich, Nov. 25, 1892. F. E. LINGING.

P.S.—This so called "Beckton grouping" of the purifiers for the purification of the sulphur compounds, I always thought belonged to Mr. H. E. Jones. I well remember his valuable paper on the subject before the Institution of Civil Engineers.

The Ulverston Gas-Meter Dispute.

SIR,—In the name of common sense, for the sake of justice, and in the interests of gas consumers, gas companies, and gas-supplying corporations, it is to be hoped the Ulverston Local Board will appeal against the decision of the magistrates in the above matter; and I am sure that, in such appeal, they will be supported by every gas company in the world. If gas accounts are to be kept by rule-of-thumb, or by local magistrates, the sooner we discard the use of the meter the better, raise the price of gas, and go back to the system in use sixty years ago, and charge a certain sum per burner, irrespective of the quantity of gas consumed.

The gas-meter being a stamped and recognized legal measure for selling gas, if found correct within a certain described margin, as the meter in question was found to be, would be binding on the *broad* back of a gas company; and it should be equally so on the *narrow* shoulders of a consumer. It is unfortunate that it was not sent direct to the inspector. At the same time, the makers are a firm above suspicion, and anyone acquainted with the construction of a gas-meter knows it would be impossible to alter it in any way without destroying the seal or stamp. Were it possible to do so, it would reflect seriously on the capability of the Board of Trade to deal with the matter. The inspector, in re-stamping the meter, only did what is customary and necessary before he could charge a fee for the examination, as the date on the new stamp would show when the test was made.

The careless and unintelligent use of gas-fires has been the cause of many a bitter dispute about the amount of a gas bill; and a number of good meters have been condemned, and consumers lost to gas companies thereby. Gas-fires are a luxury, and, if not used with great care and intelligence, an expensive one. Gas managers should, for their own sakes, make this known; for I find that the tendency of makers of stoves is to under-estimate the quantity of gas consumed. I do not for a moment suggest that they do this knowingly. But they test under the best conditions of pressure, &c.; and when a fire is fixed, and allowed to have *any amount* of gas, the only result is an enormous bill, which no one can understand.

One point in what I regard as the unjust finding of the magistrates struck me as unique. Why did they allow Mr. Walker to "pay more, than they considered was a proper charge?" If they wish to pose as gas-meters, why not fix the exact number of cubic feet consumed, as gas-meters do?

In conclusion, I can only express the hope that the Ulverston Local Board will fight this matter till the ends of justice are satisfied.

Montrose, Nov. 24, 1892. THOS. D. HALL.

Herring's Compressed Fluid Carburetter.

SIR,—I will now reply to Mr. Good's letter, which appeared in the last issue of the JOURNAL, but only to those portions relating to my method of using oil; the remainder must, if necessary, be decided by other means.

First, the ¾-inch cocks, as recommended by me, are a decided success, when used with my apparatus. For proof of this, see JOURNAL for Sept. 30 last (p. 522). Secondly, I do *not* use constant pressure, nor have I advised others to do this. Thirdly, I deny using oil as I saw Mr. Good doing when I visited his works, either before or after that visit.

I will now ask Mr. Good to read last week's JOURNAL, and then he can satisfy himself that old problems are subject to new modes of attack. As an instance, take inclined retorts. These were known and worked by Murdoch. My attack upon the very old problem of oil enrichment by *direct carbonization* was by compression. For proof of this, see JOURNAL for Dec. 16, 1890 (p. 1242). There Mr. Good will find my method described by Professor V. B. Lewes, F.I.C., F.C.S., in one of his Cantor Lectures at the Society of Arts.

Dover, Dec. 25, 1892. RAPHAEL HERRING.

Regenerative v. Ordinary Settings.

SIR,—I fear Mr. D. Irving must have overlooked the question asked by your correspondent "H. L.," in the JOURNAL for the 8th inst., respecting the yield of coke from Newcastle (Pelton Main) coal. Personally, I cannot claim much practical knowledge of the bushel; but it appears to be a very convenient measure, contractible or expansible *pro re natâ*. I am not going to dogmatize, therefore; but I must say I have a hazy notion that Mr. Irving has gone adrift with his figures, as the 48 bushels which he lays down as the yield of coke from Pelton Main coal would weigh, I suppose, on a low estimate, 16 or 17 cwt.—a return of between 80 and 90 per cent. Is this correct? Perhaps Mr. Irving or some "practical" reader will say.

Nov. 26, 1892. SANCHO PANZA.

Suicide by Gas Poisoning.—Last Tuesday morning, Sydney Casbourne, a clerk in the Controller of Stamps' Department, Somerset House, was found dead in bed at the Prince of Wales Hotel, Chatham. He had been staying at the hotel for three weeks; and during that period had spent money freely. The hotel attendants, finding that he did not appear on Tuesday, burst open his bed-room door, and were almost suffocated by gas. An examination showed that a portion of the gas-fittings had been removed; and that the windows of the room had been deliberately plugged up to exclude fresh air. At the coroner's inquiry on Wednesday, the jury returned a verdict of "Suicide by gas poisoning."

Fatal Occurrence at the Gainsborough Gas-Works.—An inquest was held at Gainsborough last Friday week, on the body of Joseph Fletcher (aged 29 years), who had been employed at the local gas-works for some years. On the previous afternoon, he was found dead in a purifier-box, which he had been engaged in clearing out. Dr. Passmore, who was summoned to the gas-works, said he attributed death to suffocation, probably accelerated by heart disease. The dense foggy weather prevailing at the time would prevent diffusion of the gases in the purifiers, and accelerate their effect upon deceased. The jury returned a verdict in accordance with the medical evidence, and recommended that two men should be employed to clean the purifier in future.

LEGAL INTELLIGENCE.

HIGH COURT OF JUSTICE—QUEEN'S BENCH DIVISION.

Friday, Nov. 11.

(*Before Mr. Justice* WILLS.)

The Gaslight and Coke Company v. The Metropolitan Railway Company.

This was an action originally brought to recover damages occasioned to the plaintiffs' mains crossing Vine Street Bridge, Clerkenwell, by the fire which occurred on the railway underneath on Sept. 15, 1890. A sum of £2250 had been paid into Court by the defendants, to meet this claim. But further claims had been put forward, and these were contested.

The ATTORNEY-GENERAL (Sir C. Russell, Q.C., M.P.), Sir HORACE DAVEY, Q.C., and Mr. DANCKWERTS appeared for the plaintiffs; Sir R. E. WEBSTER, Q.C., M.P., Mr. MOULTON, Q.C., and Mr. F. MELLOR represented the defendants.

The ATTORNEY-GENERAL, in opening the case, said that, in the events which had happened, it had ceased to be so formidable a matter as it at first seemed likely to be. The lines of the defendant Company were so situate as to cross and intersect a great many of the leading mains and connections of the plaintiffs; and the question before the Court related to serious injuries which had happened to two of the mains, which crossed the Vine Street Bridge, near Farringdon Road. They were carried across the line by means of box girders, one of which was 48 inches in diameter, and of angular construction; the other being a 36-inch rectangular wrought-iron box. The girders ran below those which supported the bridge—resting at either end on the abutment, and carrying their own weight. There was also a wooden platform constructed for the purpose of allowing the condition of the mains to be inspected from time to time. The defendants had stored under the bridge in question a quantity of naphtha; and it was now admitted that it was petroleum within the meaning of the Petroleum Acts, that the defendants had no licence to store it, and that it was not stored in accordance with the Acts—the result being that they were doing an unlawful thing. On Sept. 15, 1890, a servant of the defendants entered the store, and, it was alleged, negligently kindled a light. In consequence of this negligence, the vapour of the naphtha was set on fire, and caused great flames to burst forth, which attacked the girders containing the gas-mains. These girders, being necessarily of light construction, so as not to impose too great a burden on the abutments, were melted. This caused the joints of the mains to open, and the mains to sag; the result being a considerable escape of gas. Though at first the defendants contended there was no claim against them in respect of the injury done, they had since been better advised, and had paid into Court the sum of £2250. The plaintiffs were, however, of opinion that this did not quite represent the amount of damage they had sustained; but they did not desire to go on with the litigation further in respect of that. When the defendants paid the money into Court, they at the same time denied their liability; but he had had a communication from his friends on the other side that no question would be raised upon this. The plaintiffs had, in fact, taken the money out of Court. In section 108 of the Metropolitan Railway Act, 1854, a provision was inserted protecting the rights of the Gas Company, when the Railway Company, in laying down their lines, intersected at right angles, or nearly so, various gas mains and connections. There was no qualification of the power of the Gas Company to lay their mains on the property of the Railway Company, except that the work should be done reasonably, and so as to cause as little mischief and inconvenience as was practicable. The two mains in question were laid at different intervals; the 36-inch pipe (the smaller one) being put down in 1869. At this time an agreement was prepared. It did not seem to have been executed; and, indeed, it was not acted upon, so far as any payment under it was concerned, until a very much later date. After reciting that the Gas Company were authorized to lay their mains in a certain street, and that they had submitted plans showing how they intended to take their mains across the railway, it specified that the mode of carrying out the proposed works should be from time to time submitted to the Engineer of the Railway Company; that the Gas Company should, during the progress of the works, pay all the expenses of lighting and watching, take upon themselves all the liability of the proposed works, and indemnify the Railway Company from all loss, damage, &c., that they might sustain; and that they would for ever maintain the works in proper order and condition. The works were to be completed within a specified time; and the Gas Company were, on the execution of the agreement, to pay to the Railway Company the sum of £50, as and for the expenses to which they might be put, consequent upon the supervision and inspection of the proposed works. There could be no doubt that, as far as the Gas Company were concerned, they appeared not to have been aware of the extensive powers they possessed under the Act of 1854. In 1885 another agreement was made, relating to the larger of the two mains in question. By this the Gas Company agreed to pay a sum of £5 a year. The amount was not great; but it involved a very important principle. The plaintiffs were paying £5 a year for that which they had a legal and statutory right to do; and their case was that they entered into the agreement in ignorance of their rights, and that therefore it should not be held to be binding upon them. It was clear that the plaintiffs' advisers were in ignorance of the fact that they had, under the Act of 1854, the statutory powers which gave them the rights which purported to be conceded by this agreement, and gave it to them without the onerous conditions sought to be imposed by the agreement. He (the Attorney-General) had just been shown by his friends on the other side a document which purported to be a memorandum from the Railway Company, in which there appeared to be some reference to the statute of 1854. What that reference was, did not appear; but, at any rate, the document had not previously been disclosed in the defendants' affidavit of documents. There certainly was no allusion to any matter of the kind in the correspondence which passed at the time. In the year 1884, Mr. Harris (who was the Gas Company's Distributing Engineer) was in correspondence with Mr. Bell, the General Manager of the Railway Company, and also with Mr. Conyers, the Engineer; and, on the 8th of July in that year, he wrote a letter stating that, as there was a difficulty in carrying their 48-inch main over the Farringdon Road Bridge, he contemplated changing the route, and taking it over the Vine Street Bridge. The writer went on to say that the work would be carried out in a manner to be agreed upon between the parties, so as not to interfere in any way with the railway; and he expressed a hope that there would be no objection to its being done. This letter was not replied to; but, after some further correspondence between the parties, Mr. Bell wrote on the 15th of November in these words: "In order, if possible, to meet the wishes of your Company, my Directors are disposed to negotiate without prejudice." After this date, it was important to bear in mind that it was clear, from the correspondence, that, whatever reference might have been made to the Act of 1854, Mr. Harris, as representing the Gas Company, could not have been aware that it was inconsistent with the position that the Company had the right which it was apparent they had under the Act. An interview took place on the 22nd of November between Mr. Harris and Mr. Bell; and the latter subsequently wrote stating that his Company were willing to sanction the laying of the main over the Vine Street Bridge, subject to an agreement being drawn and duly executed, at the expense of the Gas Company, embodying conditions as to the way in which, and at whose expenses, the work was to be carried out, and as to a sum of £5 being paid by the Gas Company for the way-leave. This letter also went on to refer to the fact that the Gas Company had not paid to the Railway Company the £50 for watching and lighting in accordance with the previous agreement; and it said that the latter Company would expect this sum to be paid as a condition precedent to the work then contemplated being sanctioned. On the 1st of December, Mr. Harris wrote accepting the terms. Some further correspondence took place between Mr. J. Orwell Phillips (the Gas Company's Secretary and General Manager) and Mr. Bell, and, in the result, the £50 was duly paid. The learned Counsel then proceeded to read the agreement in detail; and he contended that it was absurd to suggest that such an agreement could have been entered into between persons who had understood that statutory rights existed enabling the Gas Company to do, without any permission whatever, the very thing the agreement gave them authority to do. There was another claim which had been set up by the Gas Company, but which would not be further pressed. It arose under the 107th section of the Act of 1854, which provided that, for any interruption in the supply of gas brought about by the acts of the Railway Company, the latter should forfeit a penalty of £50 an hour during such interruption. This was a very stringent provision, but still a very necessary one in the interests of the public. Though the Gas Company were advised that they might, in point of law, seek to recover these penalties in addition to others covering the mere damage they had in fact sustained, they did not now desire to press this part of the case. The two important points now awaiting the decision of the Court were: (1) A declaration of the right which the plaintiffs had under the statute of 1854; and (2) a declaration that the agreement before referred to was void, and ought to be delivered up and cancelled. Section 108 of the Act of 1854, which gave plaintiffs the rights they were now seeking to enforce, was as follows:—

> That it shall be lawful for the said several water and gas companies, and their respective engineers, workmen, and others in their respective employment, at all times when it may be necessary, to enter upon the railway, land, and premises of the railway company, for the purpose of laying and to lay any mains or pipes under or over the said railway, lands, works, and premises, or any part thereof, and to do all such works in and upon such railway, lands, and premises as may be necessary for laying, repairing, maintaining, or removing or replacing such mains or pipes under or over the said railways, lands, and premises: Provided always that in so doing the several water and gas companies, or any or either of them, shall not interrupt the traffic passing on the railway in any manner for any longer period than may be absolutely necessary; and provided also that the expense of all repairs or renewals of the said pipes or mains, or any works in connection therewith, which may at any time hereafter be rendered necessary by the acts or defaults of the railway company, their contractors, agents, workmen, or servants, or any person in the employ of them, or any or either of them, shall be borne and paid by the last-mentioned company may be recovered against them by the several water and gas companies respectively in any Court of competent jurisdiction.

He (the Attorney-General) understood that it would be contended on the other side that the Court would not assist the parties in setting aside an agreement which was merely a mistake at law; but, with the assistance of his learned friend Mr. Danckwerts, he should cite authorities to show that such a mistake was ample to give the Court such jurisdiction. It was not conceivable that the Railway Company were fighting this case for the sake of a mere question of £5 a year; but one could not help suspecting that it was with a view to ulterior proceedings in Parliament, where they might be able to bring forward the great grievances and obligations under which they rested, and seek relief on this ground. With regard to the first point—the declaration of the plaintiffs' right—just in proportion as any attempt was made by the Railway Company to make it clear, in their statement of defence, that the plaintiffs had not the rights they submitted they had, so did it become important that the plaintiffs ought to have their rights declared. It was not clear as to whether or not there was any dispute about the construction of the bridge.

Mr. MOULTON said they had better have this explained.

The ATTORNEY-GENERAL said in that case they would put in the box an engineer who would give the required information.

The following evidence was then called on behalf of the plaintiffs:—

Mr. *G. F. L. Foulger*, the chief of the distributing department of the plaintiff Company, said his predecessor, Mr. Robert Harris, superintended the laying of the mains under the Vine Street Bridge. When the main was put down in 1869, witness was in the Company's service, but had nothing to do with that main. He knew how the mains were laid. [Witness explained this by means of a model.] There was a wooden structure under the bridge. The gas-mains came down from Clerkenwell Green to the end of the bridge; and it was the same on the other side. There they were cast-iron circular mains; and they were connected with the box-girder mains by mouthpieces. There was no interference with the railway line in erecting the girders;

they were put together and drawn through. The two square mains were the same in construction, with the exception of the size. They lay between the girders carrying the bridge; and they rested on the abutments at either side, and on a pier in the centre. To afford facilities for inspection, there was a light wooden platform, which rested on cross girders. [Witness described in detail the construction of the bridge.]

Cross-examined: The model showed the support of the box mains on the abutments, but not the details as to their passage through the retaining walls and abutments. The bridge existed when the mains were laid; and the passages in the abutments were cut through. There was a specification for the work done in 1885. The mains answered two purposes. At certain times they were used as high-pressure mains; at others, as district mains. The 1869 main was laid when the Beckton works were built. He could not say under what Act the 1885 main was laid, or whether there were any high-pressure mains in 1854. The system was known then. The 48-inch main was used for purposes of supply, especially in foggy weather. They also sometimes worked from these mains, in order to relieve the Beckton works of the gas made there.

Justice WILLS said he did not appreciate the point of this evidence. There was no limitation in the Act as to the manner in which the mains should be used; and if improved methods were introduced, the Company would be entitled to employ them.

Cross-examination continued: The Gaslight and Coke Company did not supply this district in 1854; it was served by the City of London Company, who had their works at Blackfriars Bridge.

Re-examined by Sir H. DAVEY: The City of London Company amalgamated with the plaintiff Company in 1870, under an Act passed in 1868.

The plans of the bridge were put in.

Mr. *Monier-Williams*, senior partner in the firm of Messrs. Bedford, Monier-Williams, and Robinson, Solicitors to the plaintiffs, said there was no one connected with the firm living who brought about the agreement of 1869. The first proposal in 1885 was to lay the new main through the Farringdon Road Bridge; and negotiations were commenced with the Metropolitan Railway Company, the Metropolitan Board of Works, the Great Northern Railway Company, and (later) the Vestry of Clerkenwell. At that time, he (witness) was not aware of the Metropolitan Railway Act of 1854. He took opinion as to the rights of the parties, as appeared by the correspondence. Ultimately, the idea of carrying the main over the Farringdon Road Bridge was abandoned in favour of the Vine Street Bridge. He had never seen the letter of the 10th of September until he saw it that morning in Court. He did not hear of the Act of 1854 until just before the commencement of the present action. He attended all important Board meetings of the plaintiff Company; and, as far as he knew, the Directors were not aware of that Act. Mr. Harris never mentioned it, although he discussed the terms of the agreement with him, and pointed out one or two objectionable clauses therein. The main was actually laid before the agreement was executed—in fact, he thought before he first saw the draft of it. Mr. Harris conducted the negotiations. On the 7th of March, he received the draft from the Assistant-Secretary of the Gas Company. It was prepared by Messrs. Fowler and Perks, Solicitors to the Railway Company. He returned it with alterations approved; and shortly afterwards it was executed.

Cross-examined: He joined his firm in 1878; and from that time took charge of the Gas Company's business—parliamentary as well as general. Before that date Mr. Bedford attended to it; but he could not say for how long previously. He did not remember the firm being employed in parliamentary business for a good while after he joined. It was done by the Parliamentary Agents. Since 1878 the Gas Company had kept a sharp look-out on all Metropolitan Railway Bills, and petitioned against them, if necessary, to get protective clauses. In this matter, he was only employed to put into correct form a negotiation already concluded. It was Messrs. Fowler and Perks who first called attention to the fact that the agreement of 1869 was never executed. This was in the year 1884. He replied that he inferred that it was found no agreement was really necessary. This meant that it was within the powers of the Gas Company to go along a public roadway. He had not taken Counsel's opinion with regard to the Vine Street Bridge. He assumed that, taking all the Acts together, the Gas Company could get across the bridge under their general powers, after giving notice to the Vestry, as they could many of the bridges in London. When the draft agreement of 1885 came before him, the main had actually been laid. The Company were much pressed to get the main finished, on account of the delay that had occurred. There was a temporary main laid on the surface; and the Vestry was pressing for its removal. He personally, had no negotiations with the Vestry.

Re-examined: In one of his letters, he referred to possible litigation. It was written with reference to the opinion of Counsel which he then had before him. That opinion was with regard to the Farringdon Road Bridge, and was to the effect that the Gas Company would have to come to an agreement with the Railway Companies, the Metropolitan Board of Works, and the Vestry. It made no reference to the Act of 1854, but only to the Gas-Works Clauses Act.

Justice WILLS said it was quite evident that the Counsel who wrote that opinion had no acquaintance with the Act of 1854.

Re-examination continued: He proposed that a new agreement should be made on similar lines to the draft of 1869; but this was not acceded to.

Sir H. DAVEY said he had intended to call the Assistant-Secretary of the Gas Company, the person who conducted whatever negotiations there were; but, as this gentleman was not present, he must close his case.

Mr. MOULTON then addressed the Court on behalf of the defendants. He said his friends, of course, had chosen to put before his Lordship such evidence as they thought proper; but it appeared strange to him that, in a question in which the onus lay on one of the richest gas companies in England, certainly one which had a competent staff of officers, of showing that they had acted in entire forgetfulness of a clause in an Act of Parliament, which, on their own interpretation, was of enormous importance to them, they should have closed their case without calling the Secretary, who, according to the statement of Mr. Monier-Williams, had chiefly to do with parliamentary matters. The agreement of 1869 was undoubtedly one which had been acted upon; and, though it was not actually executed, it was undoubtedly insisted on, as was proved by the demand for, and the subsequent payment of, the £50. This agreement was exactly one which would have been entered into if it were under the Gas-Works Clauses Act; and he should contend that the terms under which the Gas Company were to cross this bridge were determined by that Act, and not by the Act of 1854 at all. The Gas Company had no right to do what they did by the Act of 1854. The only way in which they could do it was by getting the permission of the Railway Company as they did by the 1885 agreement. This was the position taken up by the defendants, and acceded to by the plaintiffs; and it was not competent for them to accede to terms like these, and then come and attempt to set aside the agreement after they had obtained the benefit of it. So far from the plaintiffs being ignorant in 1869 of the protective provision contained in the Act of 1854, they were at that time actively engaged in getting some clauses inserted into an Act which the Metropolitan Railway Company were promoting. One of the grounds on which that Company contended that the plaintiffs were not entitled to put these mains down was that they were not mains contemplated in 1854 at all. The onus put by that Act upon the bridge in question was merely that of carrying the distributing main of a small District Gas Company. Referring to the agreement of 1885, he said that, after the terms of it were arranged in the letters that passed between the parties, it was sent to the solicitors, drawn up, and executed; and it had been acted upon ever since. There was no case which had gone the length of saying that a person might get out of a compromise because he found that, if he had studied all his strict rights, he need not have entered into it; and the present case could not be set fairly lower than that. It was a case in which the Gas Company, knowing that they were under this agreement, and having good reasons for accepting it if it were only to save time, were now coming before the Court on the sole ground that they could, if they had stood on their strict rights, have refused to enter into it. This he (Mr. Moulton) would submit was not law. It would be shown by the defendants' evidence that there was neither ignorance nor forgetfulness on the part of the plaintiffs; that it was simply an attempt to get out of a compromise arising from a dispute as to their powers under the Act of 1854. It was no question with the Railway Company of saving £5; on the contrary, it was no slight matter that brought them to the Court.

Justice WILLS said it was conceded on both sides that there were very important matters at stake beyond the small monetary consideration.

Mr. MOULTON said he wished to put before the Court the view of the Railway Company with regard to mains of the kind in question. It was all very well in 1854 to allow the mains then in use to cut across their line; and it was possible that these mains, though they came subsequent to the Act of 1854, and were not mains which were within the powers of the Company who were before Parliament in 1854, might come under these clauses. But, if so, it was a most serious and terrible onus on the Railway Company, because these large pipes, being used as high-pressure mains, and the gas being driven in compression through them, might be a most serious danger should anything go wrong on the railway. The particular accident might have arisen from carelessness; but this question was not now before the Court. If ordinary pipes had been laid, it would have been a very trivial matter, and would have caused little or no trouble. These enormous vessels of inflammable material, which, as soon as they broke, had a tendency to become stores of explosive fluid on account of the amalgamation of the air and gas, would cause a most serious danger. If the Attorney-General's contention was correct, the plaintiffs, without being liable for any accident at all in any way, had the right to send mains like those in question through any portion of the defendants' works; and, if anything happened, although it might damage the defendants immensely, there was no liability at all on the plaintiffs. This was a most serious thing for the defendants. So far from being grasping, they were only doing what was reasonable when they said: "If you pass these through our bridge, in immediate proximity to our engines, you must take the responsibility of any accident, and any evil that comes from the gas." It was not unreasonable that the persons who laid mains of such an immense size should be responsible for the consequences of so doing. Therefore, it was at least reasonable for the defendants to resist such an interpretation as it was sought to put upon the Act of 1854; and it was not unreasonable for the defendants in 1885 to protect themselves against such an interpretation, by entering into an agreement which, at all events, protected them if evil arose from the size of the mains. The defendants submitted that, as this agreement was entered into with full knowledge, after full negotiation, in which the very rights expressed in the Acts of Parliament were before the parties, and was a compromise arising out of a dispute as to the rights of those parties, and a compromise acted upon, it ought not to be disturbed in any way.

The following evidence was then given for the defendants:—

Mr. *J. Bell*, General Manager of the Metropolitan Railway since 1879, said he received a communication from the plaintiffs, saying they wished to place a second main under the Vine Street Bridge, in July, 1884. At that time he was very busy with the opening of the Inner Circle Railway. In connection with the previous application, with regard to the Farringdon Road Bridge, he had caused inquiries to be made as to the powers of the plaintiffs. He had various communications on the subject with Mr. Harris, and he had an interview with him on Sept. 11. It lasted some two or three hours; and he had a note of the general result. Mr. Harris asked why the Railway Company raised any objection to the Gas Company crossing the Vine Street Bridge with their main, seeing that the latter Company had statutory powers to do so. He (witness) pressed him to state what powers he relied upon. At last he referred to The Gaslight and Coke Company's Act of 1868, and the Metropolitan Railway Company's Acts of 1854, 1861, and 1864, and subsequent Acts, and partly to clauses 107 and 108 of the Act of 1854. He (witness) intimated to him that the Directors had had an opinion as to what the Gas Company's powers really were; and they were advised that, as regards the Metropolitan Railway Company's Acts, they applied only to local mains

serving the district, and not to these enormous mains used to distribute gas from depôts miles away. They were also advised that the powers only applied to the period during which the railway works were being constructed. With regard to the Act of 1868, Mr. Harris ultimately acknowledged that their powers under it had lapsed by effluxion of time. After considerable discussion, all these Acts being referred to, he promised to consult the Board again, and write to him the terms on which the Company would grant the easement. Mr. Harris left with a threat that, if the Directors did not consent to the pipes being carried over the bridge, he would stop the railway works in the Whitechapel Road. On Sept. 24, he had a letter from Mr. Harris, asking what had been done; and one in October, saying he was much pressed to know when the works could be commenced. The Directors took legal advice in the interval; and ultimately he wrote on Nov. 20, to the effect that they were willing to negotiate. On Nov. 22, Mr. Harris again called, and the agreement was negotiated; the size of the mains being particularized. The Gas Company were to pay £5 a year, and also the cost of watching during construction, and any others. The rights of the two Companies were not then discussed. Mr. Harris said he was authorized to enter into an agreement; and they simply discussed the terms.

Cross-examined by the ATTORNEY-GENERAL: He did not think there was any reference, in the correspondence with regard to the Farringdon Road Bridge, to the Act of 1854. He did not believe they dared make such a claim when dealing with the Metropolitan Board of Works. Mr. Harris, in the course of the interview, did not say anything as to the opinion of two Counsel; but witness heard of it indirectly. Mr. Harris put forward first the Act of 1868, which he sent for; and then he gave it up. Next he mentioned the Act of 1854; and on this Act he floored him (witness) on one point. But he said the Directors had been advised that it only applied to local mains, and during construction. Mr. Harris did not agree with this, but still contended that the words were wide enough for anything. The effect was that Mr. Harris practically admitted that he was relegated to the Gas Company's own Acts, and that they must have the permission of the Railway Company. He thought he considered himself beaten, because he became rather abusive at the close. After the first interview, there was no discussion on legal rights. He handed all his papers to the solicitors at the commencement of the action; and he was as much surprised as anyone else at the letter with his memoranda of the interview upon it turning up at the last moment.

Mr. *J. J. Hanbury*, Chief Engineer to the defendant Company, said the mode in which the gas-mains were carried across the bridge was a substantial interference with the abutments and the central pier. The platform was for the purpose of inspection; and it was to the interest of both Companies that the mains should be kept in good order.

In cross-examination, witness said he could not suggest a better or more convenient way of carrying the mains across the bridge than the one employed.

This concluded the defendants' evidence; and the further hearing was adjourned till the following Tuesday.

Tuesday, Nov. 15.

On the resumption of the hearing of the case this morning,

Sir R. E. WEBSTER, on behalf of the defendants, submitted that, now the facts were before the Court, the matter was reasonably clear on the question alike of fact and of law. The relief sought when the case was opened was of three kinds—first, a claim for penalties; secondly, a claim for the rescission of the agreement of 1885; and, thirdly, a declaration that the plaintiffs were entitled to the rights given them by section 108 of the Act of 1854. In the opening, the claim for penalties was abandoned; and, therefore, in so far as any cause of action stood with respect to this, the defendants were entitled to succeed subsequently to the payment into Court of the full amount of damages which had been accepted in satisfaction. With reference to the declaration of rights, practically no argument had been addressed to his Lordship; and therefore he could only anticipate what might be said. He was not aware of any case in which a declaration had been made with regard to the abstract question of rights under an Act of Parliament re-affirming, by the order of the Court, the rights of the parties. It was not alleged, or, if so, it was not proved, that the defendants declined to allow the plaintiff Company to exercise their rights, whatever they were, under the Act. The only case in which the rights had been declared was where they had been disputed; and here there was not the slightest evidence of any application or demand by the plaintiffs to exercise these rights that had been refused by the defendants. If a declaration were made, it would be simply a *brutum fulmen*, as the rights were statutory ones, and a declaration was never made except in a concrete case, where the parties differed as to the construction of an Act, or where a plaintiff sought to exercise rights and some defendant sought to prevent him from doing so. Then, with regard to the revocation of the agreement of 1885, there were two conclusive answers, either of which was sufficient to defeat the plaintiffs' claim. The first was that, under that agreement, the plaintiffs had a great deal more than the statute would have given them; and they were now exercising those rights. They did not say they were going to take up the pipes, and relieve the defendants of the burden thrown upon them. He knew of no case where, it being impossible to restore the parties concerned to the original *status quo*, an agreement had been rescinded; and no case in which a plaintiff proposed to enjoy in perpetuity the advantages given by an agreement, yet sought to have that agreement set aside. The second answer was this: When the facts were truly examined, there never was any mistake at all; but the parties made the agreement with a knowledge of the circumstances, and with the intention of coming to a reasonable and proper agreement. The opinion of Counsel given in 1884 had very little to do with the case; but, on the face of the opinion, it was obvious that the question submitted was altogether outside the Act of 1854. The plaintiffs' Secretary, Mr. Phillips, had not been called; and Mr. Monier-Williams was only brought in to supplement the negotiations which had been carried on by the Engineers, and put them into formal shape. There was no attempt, and there could not be any, to disparage the evidence of Mr. Bell; and his statements in the box had been entirely in accordance with the memorandum he made, on the 11th of September, 1884, of the result of his interview with Mr. Harris. It was to this effect: "Sept. 11, 1884. Mr. Harris claims right of entry under (*a*) Gaslight and Coke Company's Act of 1868, sec. 62; (*b*) under Metropolitan Railway Company's Acts of 1854, 1861, 1864, and subsequent Acts; and (*c*) clauses 107 and 108 of the Act of 1854. To consult Board, and to write Mr. Harris." There was no suggestion, and there could be none, of this being a false entry. It was obvious that the matter was argued out at that interview between Mr. Harris and Mr. Bell, when it was evident that Mr. Harris was fully aware of the existence of the Act in question. Having read portions of the correspondence which led up to the agreement, the learned Counsel referred to the plans, which showed the intention that the gas-mains were to be placed actually through the Railway Company's property; holes for the purpose being cut in the structure. If anyone had come under the Act of 1854, and sought to compel the Railway Company to cut holes in their abutments, and to alter the structure of the retaining walls, in order that a pipe might be permanently supported and maintained, no Court would have construed the section to have this meaning. The section gave power to the gas and water companies to enter on the Railway Company's lands and premises to lay any mains or pipes over or under them. He had never contended that they could not erect scaffolding, or temporarily put up works on the railway; but this was a totally different thing from putting the mains actually on the property of the Railway Company, to remain there permanently, as had been done here. Lastly, he referred to a few authorities—viz., *Cook v. Wright* (Best and Smith); *Callisher v. Bischoffsheim* (L. R. 5 Q. B., 449); and *Miles v. The New Zealand Alford Estate Company* (L. R. 32, Ch. Div., 267)—which, he maintained, established the proposition that, where a disputed claim had been compromised, the Court would not interfere to set it aside, though it subsequently appeared that one of the parties had taken a wrong view of the law. On the whole, he submitted that the plaintiffs had failed on the two heads of claim, and that the defendants were entitled to judgment.

The ATTORNEY-GENERAL, in replying on the whole case, contended that the facts had in no material respect been altered from those stated by him in the opening. As he then said, the question was narrowed to two points. First of all, was there a right to have the agreement set aside; and, next, were the plaintiffs entitled to have a declaration of what were now admitted to be their statutory rights? He would deal first with setting aside the agreement. The authorities relied on by Sir Richard Webster were all cases in which there was an allegation and continued assertion of right on either side—each party insisting upon its own rights—and an agreement come to by way of compromise. The case here was not of the same nature; and the authorities to be applied to it must be sought in an entirely different direction—viz., in those cases where the Courts had found their jurisdiction to relieve people from agreements entered into under mutual mistake of what the rights of the parties were. It was clear that in 1884 it was being considered by the advisers of the Gas Company how they could best bring their mains across the Farringdon Road Bridge, which differed in one respect only from the Vine Street Bridge. Ordinarily, the roads in the Metropolis belonged to the Vestries. But the Farringdon Road Bridge was built by the Metropolitan Board of Works; and that body therefore had certain rights with regard to it. It was at that time that Mr. Monier-Williams submitted a case to Mr. Danckwerts, who wrote a long and learned opinion, the purport of which was that the Gas Company could not lay their main there without the consent of the Railway Company. It was impossible not to see that the attention of the gentleman who wrote that opinion was not called to the existence of the protective clause in the Act of 1854, or he would not have referred as he did to the question of using spaces "not dedicated to the public." This was further confirmed by the joint opinion of Sir Richard Webster and Mr. Danckwerts shortly after; and this was further borne out by the correspondence (portions of which he read), and from which it clearly appeared that, up to the 11th of September, 1884, when the interview between Mr. Harris and Mr. Bell took place, neither the Solicitors nor the Counsel advising the Gas Company had in their minds the fact that there was a provision in the Act of 1854 which gave them certain rights, whether or not the Railway Company were willing. On that interview his learned friend seemed to base the principal part of his argument; but he (the Attorney-General) submitted that the whole effect of it went most strongly in favour of the contention of the plaintiffs, and against that of the defendants. These two gentlemen met and discussed the matter. Mr. Bell told Mr. Harris that the Act of 1854 only applied during construction, and to mains intended for local service; whereupon, instead of resisting this view, and saying this advice was wrong, Mr. Harris, according to Mr. Bell's own story, said straight away: "If that is so, we must act under our own Act." Finally—and this was a significant circumstance, as showing that Mr. Harris had come to the conclusion, satisfied by Mr. Bell's argument, that he had no legal right to insist on what he was claiming—he went away, threatening what doctors called counter-irritation, and saying something to the effect that they would make it hot for the Railway Company in the neighbourhood of Whitechapel. After this there was never any question of legal rights; but the matter was discussed as to the terms on which the easement was to be acquired. There was no evidence whatever, from the beginning to the end, of any compromise, except in this sense—that when the Gas Company found themselves in a position in which they believed they were at the mercy of the Railway Company, they made the best terms they could with them. There was no question, in the assertion of conflicting claims, of right persisted in on one side or the other, and the compromise of this right. He would concede that, if, apart from this question, it could be shown that, in any substantial respect, the Gas Company were getting, under this agreement, advantages and facilities which were not given them by the Act, there was fair ground that the agreement should not be set aside. But how did the matter stand there? There was no suggestion in any part of the correspondence that there was this enormous interference with the actual structure of the bridge—the actual cutting through the bridge—which had been made so much of. This had taken place in 1869, when the first main was laid; and no harm had come of it. He had put to the Engineer what was, perhaps, a

rather risky question: Can you suggest even now any more convenient way in which the gas-main could be carried across that bridge than the way in which it has been carried? and the answer was that he could not. Therefore all this talk about cutting into the structure of the Railway Company, and imposing an additional burden on their works, was simply put forward now in the stress of litigation—not a real thing influencing the conduct of those advising the Railway Company at the time. As he had remarked at the outset, he could not appreciate the point raised by his learned friend about the way in which mains were carried. It was said that the mains must be carried over or under the property and works of the Railway Company. But this was an impossibility, taking the words literally. Having purchased the soil, the Railway Company were entitled to the whole of the earth, except the minerals, down to the very centre; and they were equally entitled to the whole column of superincumbent air up to some undefined point in the sky. Therefore, if the thing was to be done, the Gas Company must pass through the property, and the use of the words "over or under" in that section clearly must mean over or under certain parts of the works—that was to say, over or under the line of railway. It was common ground that the main could not be laid in the soil of the roadway of this bridge, because there was not room for it; and the only other method would be by a sudden declination of the pipes—carrying them down through and under the substance of the approaches to the bridge, and under the actual line of railway. No doubt the Engineer of the Railway Company would have properly objected to any such mode of dealing with it, as it would have caused a disturbance to the permanent way at the time of construction, and very possibly important interruptions of the traffic afterwards. There was no trace of any difference of opinion as to how the works should be done, when once it was settled that the mains should be carried over the bridge. Undoubtedly the work cut into the structure to some extent; but this must occur wherever the pipes were laid. A further great point—and it seemed to him the only point—was with regard to the platform; but this was not only for the benefit of the Gas Company, but was also for that of the Railway Company, as it was to everyone's interest that the mains should be preserved in perfect order. The Gas Company, therefore, obtained under this agreement nothing but what they had a right to—in other words, they had paid a purchase price for what was their own. Sir Richard Webster had referred at great length to what the plaintiffs had done; but he did not suggest what ought to have been done, and what could have been done under the statute of 1854. In other words, he did not point out in what single respect the plaintiffs had obtained anything under the agreement that they were not entitled to get under the statute. Then it was said that there was no authority to cut through the works of the Railway Company. This was so with regard to the Act of 1854; but, under the Act of 1868, express powers were given for breaking up streets, railway bridges, rivers, aqueducts, &c. The learned Counsel then referred to the authorities which he contended established his proposition. He started with the fact that the plaintiffs had the right to do the very thing which they did, and in the manner in which they did it. Were they, he asked, to be held by the agreement which bound them to buy a right which was already their own in point of fact and law? The first case was the old one of *Bingham v. Bingham* (1 Ves. Sen., 127), decided in 1748, where, the plaintiff being in possession of an estate, the defendant claimed it, and brought an action for ejectment. Thereupon, to stay proceedings, the plaintiff bought the estate from the defendant. It was decreed for the plaintiff, with costs; for though there was no fraud on the part of the defendant, who believed he had a right, there was a plain mistake, such as the Court was warranted to relieve, and not suffer the defendant to run away with the money in consideration of the sale of an estate to which he had no right. The next case was one of *Cooper v. Phibbs* (2 English and Irish Appeals), in which Lord Westbury explained the real meaning of the maxim "*Ignorantia juris neminem excusat*," and pointed out that the "*jus*" there referred to was the ordinary law of the country, and not the private rights of the parties. He read passages from the judgments of Lord Cranworth and Lord Westbury, and also cited a case of *Jones v. Clifford* (L.R. 3, Ch. Div., 779) and *Milton v. Hutt* (3 De Gex and Jones).

Justice WILLS asked if there was any case in which both parties had been on exactly the same footing with regard to the facts and all the materials necessary to form a correct judgment as to the law, and in which they met one another fully at arm's length, and one convinced the other by his arguments.

The ATTORNEY-GENERAL said he did not know of a case exactly like that. The nearest approach to it was the case of *Cooper v. Phibbs*, because there both parties were in the same position—not knowing what their relative rights were.

Justice WILLS said this was a very peculiar case. If an agreement of this kind could be set aside, people would be very imprudent to argue with those whom they were dealing with. They had better take their stand on their own view, and make the best of it.

The ATTORNEY-GENERAL said he did not quite see that. Supposing no argument at all had taken place, the position of things would have been precisely the same. The defendants believed there was no such right, and the plaintiffs also believed there was no such right, as that claimed.

Justice WILLS: But the evidence of it would fail if one said: "I shall insist on my rights, and I shall be able to stop you;" and the other said: "No, you will not," and there was no further discussion. There could then be no evidence of a common mistake.

The ATTORNEY-GENERAL contended that here, from beginning to end—in the negotiations preceding the taking of the opinion of Counsel, in that opinion, and in all that subsequently transpired—there was evidence of this common mistake. It was not merely a question of law; it was a question of the particular statute and subsequent statutes in the matter in hand. It really came to this: The plaintiffs had entered into an agreement to secure to themselves a favour for a payment, and to take upon themselves an obligation which there was no shadow of authority for suggesting could be put upon them. With regard to the first branch of the case—the declaration of right—he submitted he was entitled to have that on account of the state of the pleadings, in which the defendants denied the plaintiffs' rights under the section in question. He maintained that the case was one in which it was now demonstrated that the agreement in question was entered into under a mutual mistake; that it was not a compromise in any sense, either as to the terms of the agreement itself or as to the mode in which the work was carried out; that it gave the plaintiffs nothing that they were not entitled to under the Act; and that their own Engineer admitted that the things had been done in the most convenient way. The question therefore was: Should they be bound by an agreement under which they got that which was already their own, and further continue to be burdened by onerous and unreasonable stipulations as to being liable for damage which was not the result of their own negligence? It was a declaration they were entitled to, because it was distinctly traversed in the defence. With regard to the costs, of course the plaintiffs were entitled to the costs up to the time of the payment into Court; and this, he understood, was not disputed. The costs since that time would, of course, depend upon the view which his Lordship took of the case.

Mr. MOULTON said he had only a few words to say on the cases cited by his learned friend. The first case referred to—that of *Bingham v. Bingham*—was so very briefly reported that it was impossible to ascertain the facts, or to get any definite rule of law from it beyond those laid down in the later cases. In these the facts differentiated them from the present case by what seemed to him to be the broadest distinction, and one which went to the very root of the matter. In all these cases there was mistake, and relief was given, because the parties had contracted under a mutual error; but in neither of those cases was the doubtful point present as one of doubt to the mind of the parties contracting. He felt confident that no case could be cited where the parties contracted, knowing there was a disputed point and coming to an agreement, in which the Court had set it aside because one party was right and the other wrong with regard to that disputed point. Claims were perpetually being made which might lead to lawsuits, and persons with a knowledge of their disputed rights constantly made agreements to settle the matter; and it had always been held that these agreements would be supported. If an agreement were made without an important fact being present to the mind of either party, the Court might say it would be set right; but to tamper with the power of making compromises in a case of disputed rights was a thing which no decision of the Court had ever favoured.

His Lordship reserved judgment.

Saturday, Nov. 26.

To-day judgment was delivered in the case.

Justice WILLS said: This is the action in which the plaintiffs, The Gaslight and Coke Company, sued the defendants for a sum of money for damages for destruction of their property under circumstances for which they contended the defendants were liable; also claiming a declaration that the plaintiffs are entitled to the rights which were secured to them by the Metropolitan Railway Act, 1854, and also claiming the rescission of an agreement. The first part of the claim is cleared out of the case by a payment into Court, which has been accepted, and which therefore disposes of that matter. The next question is whether the Act of 1854, sections 106 to 108, which contains provisions in favour of the Gas Company, securing to them certain rights of passing their mains over and under the properties of the Metropolitan Railway Company, is still in force. Upon this point, I cannot entertain a shadow of a doubt that it is in force. The argument for the defendants that it is not in force, appears to be that, by The Gaslight and Coke Company's Act of 1868 (which repealed several former Acts, and substituted a number of consolidated provisions for them, and which comprehended a variety of provisions which were before scattered over a number of Acts), the Gas-Works Clauses Act, 1847, gave merely a power of passing over private land with the mains of the Gas Company, by the consent of the owner of that land; and therefore the compulsory rights which were given to the Company by the Metropolitan Railway Act of 1854 are gone. I cannot understand that argument. It seems to me to be contrary to all principles which are applied, or which could apply, to such matters; and, as if to make it more clear, the Gas Company's Act of 1868 has a provision, under section 9, that all the provisions of every Act of Parliament other than the repealed Acts relating, amongst other things, to the Company, "shall apply to the Company under this Act, and in accordance with the provisions of this Act may be exercised, enforced, and enjoyed by and against them respectively in as full and beneficial a manner to all intents and purposes as if this Act were not passed." It is said that the words "in accordance with the provisions of this Act" imply a limitation, and mean that the former compulsory power shall only be exercised subject to the consent which is required by the Gas-Works Clauses Act. I cannot conceive it for a moment. It seems to me that the powers which were given by the Metropolitan Railway Act were certainly not interfered with by anything in this Act; and therefore, in my opinion, the case for the plaintiffs on that point is made out, and they are entitled to the declaration they ask for, which is a matter as to which I really cannot bring myself to entertain any doubt whatever. The third question is as to rescission of the agreement. This is a question of much more difficulty. Now, the case of the plaintiffs, who ask for the rescission of the agreement, is this: The agreement was made in 1885. It was one under which the plaintiffs were allowed by the Railway Company to cut through the structure of a bridge—that is, through the piers supporting the bridge by which Vine Street is carried over the Metropolitan Railway; and a number of rights were secured in perpetuity to the plaintiffs which were more or less connected with the maintenance and repair of the gas-mains which were thus carried across. It is said that, under section 108 of the Metropolitan Railway Act of 1854, to which I have just alluded, the plaintiffs had the right to do all that they did without consent. It was first said that both parties to the agreement had lost sight of the provisions of section 108, and were ignorant that rights under that section existed; and, secondly, it was said that it was an agreement made under a common mistake of their rights by both parties, and therefore, according to certain decisions (to which I need not allude at length), it could not be supported

when the rights were once ascertained, and the agreement was challenged. Well, the facts disposed of that argument of the case so put, because it is as clear as anything can be that the two parties who alone were negotiating this agreement were perfectly aware of the Act of 1854; and of this specific group of sections. Then the plaintiffs changed their ground upon this point, and said: "Well, it may be that our original case—namely, that the Act of Parliament itself had been lost sight of—is disposed of; but it still remains the case that both parties were erroneously under the impression that the Act of Parliament did not give the right in question, and therefore there is still an agreement, which has been come to under a common mistake as to a very important right, and therefore it cannot be sustained." It is necessary, therefore, to apply myself to two questions—first, whether the Act of Parliament did give the rights which have been exercised; and, secondly, supposing that it did, is this a case to which the doctrine applies that an agreement which is made by both parties labouring under a common mistake as to rights may be rescinded. In the first place, as to whether this Act of Parliament gave the right to do what was done, I listened to really a very powerful argument by the Attorney-General, which convinced me that it did confer the rights. But, after ample consideration, I am really unable to come to that conclusion; and I arrive, on the contrary, very clearly to the conclusion that section 108 of that Act did not give the rights which were actually exercised. Section 108 is in these terms; "That it shall be lawful for the Gas Company to enter upon the railway, lands, and premises of the Railway Company for the purpose of laying and to lay any mains or pipes under or over the said railway lands, works, and premises or any part thereof, and to do all such works in and upon such railway, lands, and premises as may be necessary for laying, repairing, maintaining, and removing or replacing such mains or pipes under or over the said railways, lands, and premises." That is a section which gave the right without qualifications; the only reservation in favour of the Railway Company being that the Gas Company shall not stop the Railway Company's trains unnecessarily. There was some discussion as to whether the structure that was used for the purpose of repairing the pipes from time to time would not of itself be sufficient without that section. I am not the least influenced by that argument, because, if there was a power to carry the pipes through, and to pierce the Railway Company's supports of the bridge, I think those words about doing everything that is necessary for repair are ample to carry that which is a perfectly reasonable and convenient way of securing that repair, and that which would benefit both parties rather than damage either. But where I am unable to follow the Attorney-General's argument is that I cannot think this power to lay mains "over and under" does give a power to pierce and penetrate every permanent structure of which the Railway Company are entitled to say they are the owners. It seems to me, if there was such a power, and if it had been intended to be given, seeing how very large this is, and what very serious consequences it might entail, there must have been some provision for ascertaining the way in which it should be done, and it really cannot have been intended that the Railway Company should be put at the mercy of the Gas Company to do whatever they thought fit in that respect. The Attorney-General said that, of course, one must import into it the qualification that it is to be "reasonably and conveniently" done. Well, as to being "reasonably" done, of course all powers must be exercised reasonably. "Conveniently" reminds me of the question which was put from the Bench, and which is said to have upset once and for all the decision in *Hole v. Barlow*, where it was said that a nuisance might be carried on in a reasonable manner and in a convenient place. A question was put: "Convenient to the plaintiff or to the defendant—which?" I think it is perfectly clear that, with respect to matters of this kind, there is always liable to be a difference of opinion between the Metropolitan Railway Company and the Gas Company as to what is a "reasonable and convenient" way of doing it. There is no method of settling this. It can hardly have been intended that such a question as this should be open to the decision of a jury, after the thing had been done, in case of dispute. It seems to me a violent stretch of language, looking to the subject-matter of the enactment, to say that power to carry pipes over and under the "lands, works, and premises of the Metropolitan Railway Company" really gave the right *in invito* (because, of course, that is what it must be, if it is a power at all) to cut through the permanent works, and make holes in the piers of their bridges and so forth. It is not for me to say what the limits of the powers are, or how they are to be exercised in any particular case. It is enough to say, with regard to the present case, that it does seem to me that the cutting through the permanent structures of the piers of the bridge was a thing which could not have been insisted upon, if the Railway Company had been disposed to contest it; and that therefore it was outside the powers which were conferred upon the Gas Company. I dare say it would not have made any difference, because it is not contested in this particular instance, that what has been done has been done "conveniently" enough to both parties; and in all probability, if the thing had to be done at all, it would have been by agreement and without objection, in the way in which it has been done. That is not quite the question here. The question is whether there was a power to do it if it was objected to. Coming now to the question of fact, about whether a case has been made out for the rescission of this agreement, it is clear that, at the time the negotiation took place, the objections which were taken by the Metropolitan Railway Company, or those who represented them, were not by any means as to the mode in which this right should be exercised, as to which, as I have already said, I do not think they would have raised any objection if it had been that question alone; but, in the clearest language, they disputed the right altogether. Then the Gas Company's solicitors had the matter in hand, and attempted negotiation for themselves with the solicitors for the Metropolitan Railway Company; and these negotiations were carried on up to about June or July, 1884. I accept entirely, of course unreservedly, what Mr. Monier-Williams said—that he, when he was negotiating on the part of the Gas Company, did not know of this Act of Parliament. I see no evidence at all that Messrs. Fowler and Perks did not know of it; and no case has been made to show that they did not. But this matter I regard as purely immaterial, because the real and effective negotiations were carried on by Mr. Harris, the Engineer for the Gas Company, and Mr. Bell, the Secretary and Manager for the Railway Company; and the solicitors on either side did not appear again, or take any part in the negotiation, until all the terms had been settled. All they did was to put the terms which had been agreed upon into a proper and formal agreement. Therefore, their knowledge and their state of mind are wholly immaterial; and the question to be considered is what was known to Mr. Bell and Mr. Harris, and what was their conduct? Before I go into the facts, I will just say one word upon the law; and it does not want much more than that. It seems to me that it is undoubtedly the law—and there are cases in the House of Lords (and especially the case of *Cooper v. Phibbs*, in 2 English and Irish Appeals, p. 149) which establish it—with respect to such legislation, such Acts of Parliament, and such matters of construction as bear upon private rights, that, if there is a common mistake on important matters going to the root of the rights of both parties to the negotiation, then it is an agreement that ought not to stand, and would be set aside if it were challenged at the proper time. But then there is another line of decision which, under particular circumstances, as in those of the present case, converges very much towards certain developments of the other line to which I have already alluded; and that second line of decision is equally clear. If the two parties are dealing with one another at arm's length, and negotiating for the settlement of rights which are in dispute, and which may lead to litigation (though I do not think the fact of litigation being contemplated, or being particularly liable, under the existing circumstances, to arise, is anything more than a circumstance in the case—I do not think it goes to the principle), and if the parties are taking up different lines as to their rights, and are dealing with one another upon equal terms, there is no case to raise the suspicion that one party has misled the other, or has been guilty of an abuse of his position towards the other, or anything of that kind, then, if an agreement was come to for the purpose of settling controversies, and giving both parties the advantages which an agreement would bring about in place of their strict rights of appeal to the Court to settle, I think that agreement will stand, and must be upheld. It is the clearest possible justice that it should be so. And the real question here is, as it seems to me, which of these two lines of decision—which may in particular cases, as in the present one, somewhat conflict—is to prevail, and what is the substance of the transactions with which I have to deal? The evidence is very short; but it is very conclusive upon the point. After the solicitors had done their best to bring about an agreement, and had failed, Mr. Harris and Mr. Bell took up the matter; and, after a little correspondence, a meeting took place on Sept. 11, 1884. Then we have excellent information as to what occurred—at all events, the substance and gist of it—because a letter was discovered quite late in the case, but it was ascertained to be perfectly genuine, upon which Mr. Bell had, at the time, made a pencil memorandum, which is before me now, of some points of his interview with Mr. Harris. It appears undoubtedly that Mr. Bell asked Mr. Harris under what authority he claimed to have the right to carry his mains over the Metropolitan Railway Company's premises without their consent, and Mr. Harris referred him specifically, amongst other things, to the Act of 1854, sections 106 to 108. Therefore it is quite impossible to doubt that both parties were perfectly well aware of the enactments. Then Mr. Bell took two objections to the applicability of these powers—both of them, I think, very bad ones. He said, in the first place, that this was one of those compulsory powers to which the five years' limit contained in section 51 of the Gas Company's Act of 1868 applied. I do not think there is anything whatever in that. It is a power which, from its very circumstances, was intended to be permanent. He also said that section 51 contains an enactment that the Company shall be at any time entitled, notwithstanding the expiration of their powers, to lay fresh mains, make alterations, and so on. In my opinion, this was not a compulsory power to be exercised under the Act of 1868, or any of the Acts incorporated with it; and it appears to me to have been a very bad argument. Then he further said that it gave them power to carry ordinary pipes, but not to carry great gas-mains. This seems to me to be equally bad. But they discussed it. I cannot help feeling a suspicion that Mr. Bell has taken an extravagant view of his own powers of persuasion in argument; I gather this from his own memorandum, because it ends by saying that he was to see his Directors and communicate further with Mr. Harris. There was absolutely nothing for him to see the Directors upon, if, as he says, they came to a common understanding that the Gas Company had not the powers which they claimed, and that they were at the mercy of the Railway Company in this respect. But, at any rate, these two men, who had the conduct of the negotiations, and who were both of them perfectly competent to judge for themselves, discussed the matter; and Mr. Harris, to use a common phrase, "knocked under." I cannot conceive myself, because he was convinced, if he was convinced, by a bad argument, and because he knocked under unnecessarily and inadvisedly, that there is anything in that circumstance to remove the case from the ordinary one of people who come to an agreement in order to close matters which it is of great importance to them to close. No one can doubt the extreme importance to Mr. Harris's Company of settling the matter then in some way, instead of going to further litigation. It appears that he had already laid his pipes across the bridge. They were an obstruction to the highway; and the Vestry were pressing him exceedingly to take them away. This had been going on for months. Of course, both he and his Company were very anxious to get some arrangement without litigation, which would have meant much further delay, that would have enabled them to carry their mains across as they did. It seems to me that this is precisely within the principle of a very numerous class of cases; and it is a matter on which I cannot persuade myself any case was necessary. I do not think there is any real controversy or difficulty about the law. My judgment therefore is that the plaintiffs are entitled to the declaration for which they asked, but that so much of the action as relates to the rescission of the contract must be dismissed. They are entitled to the general costs in the cause, including all the costs which are applicable to the sum paid on that part of the claim; and the defendants are entitled to such costs as are applicable to the particular issue upon which they have succeeded.

MISCELLANEOUS NEWS.

THE RELATIVE COST OF GAS AND ELECTRICITY.

In the current number of the *Engineering Magazine*, there is an article on the above subject by Mr. C. J. Russell Humphreys, the reproduction of the principal parts of which may be interesting in connection with what has lately appeared in our columns. It should be mentioned that the writer, of course, looks at the question under discussion from an American standpoint.

The author begins by remarking that the electric lighting industry has reached an age at which it would not be amiss to glance at the question of cost as compared with the older illuminant—gas—which people were once told was to be speedily consigned to the background. But he points out that, such is the receptive capacity of the world for new industries, that, though a vast amount of the newer illuminant has been absorbed, it does not follow that the use of gas has decreased to a corresponding degree. On the contrary, more gas has been burnt year after year—a fact which shows that employment is being found for a larger quantity of artificial light. A glance at night along the main thoroughfares of any large city will show a vast increase in the amount of light used, as compared with twenty years ago. Much of this is, however, purely for advertising purposes. It no longer suffices to have a store lighted so that salesmen and customers can find their way about before and behind the counters, and stop at that. The whole interior of the shop, and the exterior as well, must be flooded with light; and whether the lighting agent be gas or electricity, it must be of high intensity, and in large volume. The effect of this is far-reaching, for the merchant who grows accustomed to bright lights in his store or counting-house, insists on having a great deal of light at his home. Nor is this all. In days gone by, it would suffice if the streets were lighted with lamps few and far between; but now they must be lighted in the fullest meaning of the term. Again, the tendency in recent years to erect "sky-scraping" buildings, which shut off the natural light from the smaller edifices and the lower storeys of the larger ones, entails the use of vastly increased amounts of artificial light during that portion of the 24 hours when Old Sol was once supposed to do all the lighting business. Thus it happens that this great receptive capacity of the world for artificial light has led to the building up of a large business for the electric light corporations, without by any means "snuffing out" the older illuminant.

In support of the foregoing assertion, Mr. Humphreys cites the case of the gas companies in Massachusetts, who made last year 20 per cent. more gas than they did in 1889. This, he goes on to say, is the more remarkable when we consider the business done by the electric lighting companies of the same State. The figures for 1891 show that the gross receipts of these companies were equal to 45 per cent. of those of the gas companies—a statement which is at once a testimonial to the energetic manner in which the electric lighting business has been pressed, and evidence of the increasing demand for artificial light. To illustrate the latter tendency in another way, it may be shown that in the same State, during 1889, the capacity of the incandescent electric light companies aggregated 84,400 lights, reduced to the standard 16-candle lamps, whereas in 1891 the figures had grown to 183,120 lamps. During the same years, the capacity of the arc light stations increased from 11,529 to 15,338 lamps.

The questions now thrust themselves upon our attention: Is this rapid growth to hold for the future? and how will it affect the sale of gas for lighting purposes? Brushing aside vague generalities, we must admit that the answer depends very largely upon the relative cost of gas and electricity. An element to be considered, perhaps, is whether the electric light companies have been doing business at unremunerative rates; thus achieving a doubtful prosperity. If we refer to the report of the Gas Commissioners of Massachusetts for the year 1891, we shall see that the interest earned on the capital invested in 61 electric light companies doing business in that State was about 5½ per cent., and at the same time there was charged for depreciation only about two-thirds of 1 per cent. on the capital stock. It would seem, therefore, that many electric light companies are doing business for the benefit more of the public than of the stockholders. Doubtless many of these companies are in their present uncomfortable position by reason of mistakes in early construction, or the selection of unfortunate sites for their works, and will in time work out of their difficulties. Such mistakes are inseparable from the starting of any industry. Still, it is well, if anyone is inclined to undue elation at the progress made by the electric light companies in gross earnings and increase in plant, to temper his joy by a calm perusal of the net result, in order not to deceive himself.

The question now arises: How can we compare the relative cost of gas and electric light? We must reduce our figures to a common standard, which will be 16-candle light, and then consider the relative amount of capital required in each business per unit of light, and the percentage of gross receipts in each case required to pay the expenses of manufacture and distribution. We may then inquire which light will produce to the company the larger gross revenue per standard of light, which is merely another way of saying whether the public are willing to pay more for one light than the other. It is probably safe to say that the capital required by an electric light company engaged in central station lighting will approximate $30 per unit of light capacity of the station, or $30 per dynamo capacity of the station reckoned on a basis of a 16-candle light. This, however, does not afford at once an opportunity to compare the relative capital required by the two industries. It is customary to figure the capital in the gas business at so much per 1000 cubic feet of gas annually sent out; and when we assume this figure to be $6, we are not yet in a position to make any comparisons, as in one case we have merely the dynamo capacity of the station, and in the other the total output from the gas-works. We must, therefore, reduce our figures to the basis of a lamp-hour—that is, the light of 16 candles for one hour. This means, in the case of electricity, that we must determine about how many lamp-hours, on the average, will be sent out by an electric light station for each 16-candle light capacity thereof. And in constructing an average daily load-card, we must remember that, up to date, it does not seem feasible to store electricity, and that therefore the capacity of the station must be equal (and still have a proper margin for reserve) to the maximum demand for light in any hour—as, for instance, during the busy hours of a Saturday evening in winter. A gas-works, with proper storeage capacity, can lay up during the week enough gas to meet the heavy requirements of Saturday evening; but not so in the electric-light station. Here the plant must be equal to the maximum call; and, further, there must be a fair reserve then; for that is just the time that an accident resulting in the shutting off of a portion of the lights of a city would be borne with the poorest grace. So we will assume a reserve of never less than 25 per cent., and on that basis construct a load-card for the average day of the year; thus arriving at the average lamp-hour output per 16-candle lamp capacity of the station.

Number of Hours.	Output per Cent. of Dynamo Capacity.	Output per 16 c.p. Lamp Capacity of Station.
One	0·45	0·45
Two	0·10	0·20
Three	0·25	0·75
Eighteen	0·05	0·90
Total output		2·30

This is an average output per hour per 16-candle power lamp capacity of station of 2·30 ÷ 24 = 0·090 lamp-hour, which would give us 839·5, or (say) 840 lamp-hours per year for each 16-candle power lamp capacity. From this we find the capital required per unit adopted for comparison—viz., 3·6c. In the case of gas, we will assume that $6 is the capital per 1000 cubic feet of yearly output, and that the gas is 18-candle power (which would, of course, be low for New York City, but would hold as a good average); and we find in this case the capital required is 2·6c. per standard of comparison. In different language, the capital required per 16-candle lamp-hour output is as follows: For electric light, 3·6c.; for gas on the same basis, 2·6c. According to this, the electric lighting plant requires 40 per cent. more capital for doing a given amount of business.

When we come to compare the relative cost of manufacture of gas and electricity, and express the same in percentage of gross receipts, we find a further difficulty of comparison from the fact that the gross receipts from electric light per unit lamp-hour are greater by about 28 per cent. than in the case of gas; therefore, to compare the cost of the two lights, we must make the comparison in percentage of the gross receipts for gas. When we reduce the receipts and expenditure to our common standard—a 16-candle lamp-hour—and express the relative cost of the two systems in percentage of gross earnings, we find the following results: Cost of gas, 71 per cent.; cost of electric light, 91 per cent. Otherwise expressed, the unit of light costs by electricity 20 per cent. more than by gas.

We thus find that, in order to obtain the unit of light from gas or electricity, we must invest 40 per cent. more capital in the electric business than in gas; and the cost of making the unit of light will cost by electricity 20 per cent. more than by gas, as expressed in percentage of gross receipts of the latter. As the earning of a 6 per cent. dividend on the capital invested requires, in the case of gas, an amonnt equal to 26 per cent. of the gross earnings, and as the capital required in the electric business per unit of light is 40 per cent. greater than in the gas industry, it follows that, in order to obtain a profitable investment from the electric business, we must obtain for dividend an amount equal to 36 per cent. of the gross earnings from gas. That is, if A = the gross receipts from gas per unit of light, we must obtain for electric light (A + 91 per cent.) + (A + 36 per cent.) 127 per cent. of the price of gas; which simply means that, if gas sells for $1 per 1000 cubic feet, the selling price of electricity for an equivalent light must be $1·25.

That this is the practical result so far is evident from the fact that, as before noted, the receipts from electricity per unit of light are about 28 per cent. greater than from gas. It avails nothing to say that this statement is disproved by the operation of electric lighting companies in certain cities, where they are selling electricity at the same price as gas, and paying dividends; for we are not concerned with individual cases, but dealing with average results. Such exceptions to the rule might be explained by an abnormally high price for gas in those cities, or by the fact that the electric companies have confined their operations to the thickly-settled portions of the cities, and have taken only the best-paying customers—those of long-burning hours. But these cases do not offer any suitable basis for comparisons.

We have based our figures on a 16-candle power unit, not forgetting the claim of the advocates of gas lighting that what purports to be a 16-candle electric light fails to give the consumer any such amount of illumination, because the incandescent lamp so soon falls off in efficiency. While conscious of this fact, we have disregarded it in our calculations, because we are dealing with comparative results. Besides, this loss is pretty well balanced by that which the gas consumer suffers from poor burners. The loss in efficiency in the former case may be more rapid than in the latter; but as it is darkest before dawn, so the incandescent lamp, as it approaches its period of lowest results, nears the time when it will be replaced by a new one; thus giving the customer the dawn of better things, in the shape of the original strength of the incandescent lamp. But the gas consumer, while, perhaps, suffering less proportional loss on account of a defective gas-burner, is apt, through ignorance of his loss, to bear it for a longer time; hence these losses may be held to balance each other.

The electrician may say that the results here noted have been reached with small dynamos and single-cylinder engines, entailing a large expenditure of capital per unit of light and a high running cost; and that, in future, we shall have machines of greater economy. True, we have based our figures on results obtained, and not on the hopes of the future. But this must perforce be the case; for were we to temper our figures by the possibilities of the future in the case of electricity, it would be necessary to do the same with gas lighting. We are trying to deal with facts, not prophecies. We are not unmindful of the economies offered by the new and large dynamos, wherein two dynamos are connected directly on one foundation with a triple-expansion engine. We realize the economy that may be

effected in the capital account, and in the daily running expenses. But we also have before us the improved results which are flowing from the combination of coal and water gas, wherein the residuals of the one system are converted into gas by the other. Nor is our vision stopped by the view of the inclined gas-retort; allowing the coke from the coal-gas system to fall by gravity into the water-gas generator—thus reducing the labour account to the minimum. But we see the coal dumped by mechanical means into huge retorts, in which, first, the coal is deprived of volatile constituents by carbonization, and then, by the changing of a few valves, the retort becomes a generator, and the residual coke is converted into carbonic oxide and hydrogen gases with practically no labour. If we are to discount the future, and figure on the possibilities of reducing the cost of electricity by improvements in the steam-engine, then we must consider also the possibilities before the gas engineer in converting the energy of the gas into light; remembering that, by our present wasteful method of burning gas, we actually utilize a scant 8 per cent. of the energy of the gas—the balance passing off as low heat-rays.

For these reasons, we confine our observations to the present, and leave the future to care for itself, remembering that both gas and electricity have their inception in the coal pile, that both systems waste a large amount of precious energy, that both schemes of lighting offer great rewards to those who will reduce this waste, and that in the long run that system will predominate which gives out, in the form of light, the greatest percentage of the energy of that substance which we all regard with indifference, but which future generations will husband, guard, and protect with jealous care—coal.

GAS, ELECTRICITY, AND WATER AT HUDDERSFIELD.

The retrospect of the work of the official year submitted by the Mayor (Mr. Alderman R. Hirst) at the recent annual meeting of the Huddersfield County Borough Council was a highly interesting one. Speaking of the Gas Department, he said the year had been a progressive one; and, although financially it had not resulted as satisfactorily as might be wished, it had nevertheless been such as to compare very favourably with other similar undertakings. An increase of 3 per cent. had taken place in the production of gas, which necessitated the carbonization of 1600 tons of coal and cannel more than in the previous year. The weight of coal and cannel used during the twelve months was 48,318 tons, as compared with 46,700 tons. There were now 18,050 meters in use, or an increase of 330 for the year. Having referred to the change in the management, he mentioned that a 36-inch trunk main, 2310 yards long, had been completed; and an 18-inch main was now being laid through the Moldgreen district. Of other sized mains, 237 6 yards had been put down. Satisfactory progress was now being made with the erection of the oxygen producing plant; but up to the present time the Northern Counties Hydro-Oxygen Gas Company had not sent the designs for the oxy-oil gas plant. The time, however, had not been altogether lost, as it was understood that considerable improvement had been made in the oil-gas plant at the suggestion of the Engineer, with a view to its being more applicable to manufacturing oil gas on a larger scale, since it was inspected at Manchester by a Special Sub-Committee in May last. Certain extensions had been made at the Leeds Road works; and there was no doubt that a considerable sum of money would have to be expended on structural work in this department during the coming year. But it was satisfactory to note that it would be recouped in a two-fold manner—first by cheapening the cost of production, and, secondly, by a better and purer quality of gas being supplied for public consumption. On the matter of electric lighting, the Mayor stated that the Local Government Board gave their sanction to the borrowing of £50,000 in May last; and the Council were then able to enter into the following contracts and commence work: For the buildings, machinery foundations, chimney, and flue, £8548; for the generating plant, which will be capable of supplying the energy for 4000 16-candle power incandescent lamps, including underground mains, transformers, and controlling apparatus, £20,640; for the 16-inch cast-iron pipes for carrying the water required for condensing from the canal to the electric supply station and back to the canal, £406—making a total of £29,594. It was hoped that the electric supply would be commenced in the spring of the coming year. As to the Water Department, the total quantity of water supplied inside and outside the borough during the past thirteen months was 481,356,000 gallons, as compared with 484,436,000 gallons in the preceding twelve months—the population supplied being 140,890, as against 139,145 last year. The net income for water in the year 1892 was £54,552; and for the thirteen months ending March, 1893, it was estimated that a net income of £51,825 would be produced.

MORE AGITATION AMONG GAS WORKERS AT KEIGHLEY.

During the past summer, as recorded in these columns at the time, stoking machinery was introduced into the retort-houses at the Keighley Corporation Gas-Works; and this brought about changes in the conditions of labour, which produced some amount of discontent among the men. However, after negotiation, the matters in dispute were amicably arranged; and for a time the work proceeded in its usual manner. But tranquillity was not to continue long without efforts being made to again disturb the men. Among those who are doing their best in this direction is Mr. A. Burrows, the Secretary of the Keighley Trades and Labour Council. He has written a letter to a local paper in which he likens the condition of labour at the works to a little hell on earth; and since then, at a public meeting, he has stated that he is more than satisfied that this is perfectly true. On this occasion he also remarked that the ratepayers little knew what underhand work there was going on in connection with the gas-works. They found men working there from six o'clock in the morning till close upon six o'clock at night (he had the men's authority for saying it) in a suffocating heat and an atmosphere reeking with sulphur and smoke, with a deficient water supply—certainly not enough to wash in—and the men suffering from blistered feet all the year round. And what, he asked, had the introduction of machinery done for these men? They assured him that the work was more laborious than before; and after thousands of pounds of the ratepayers' money had been spent in experimenting, the men were desirous of going back to the hand system. He was informed by them that the machines had failed at Bradford and elsewhere; and that hand labour was the more economical plan of the two. But the worst feature of the case was this: When the men obliged their superior—who was himself only another servant of the Corporation with a big "screw"—by going on as they were until all the retorts were "put on," hope was held out to them for the future. What was the result? They had gone from eight-hour shifts to what were practically twelve-hour shifts, with scarcely an hour for breakfast and dinner. When negotiations were recently proceeding, three persons were appointed by the Gas Committee of the Corporation to see that an arrangement was properly carried out; and one of these persons told the men that, before the town should be short of gas, he would take off his coat and work himself. The men made answer that they only wished he would, because he would soon throw down his tools, and their grievances would be the more readily redressed. But for himself and another gentleman the stokers would have thrown down their tools only the previous day, because the deputation from the Corporation were only prepared to make a concession on minor points; and therefore the ratepayers must not be surprised if the stokers gave in their notices, and left work. He declared that he was sorry to have to interfere in a matter of this sort; but it behoved them as ratepayers to see that one servant of the people did not sweat other servants.

PHILADELPHIA GAS SUPPLY.

The report of the Chief of the Philadelphia Gas Bureau (Mr. W. K. Park) for the past year discloses an improvement on the operations of the department in the preceding twelve months. More gas was manufactured, more money received, and the profits were greater. The yield of gas per pound of coal carbonized (the datum employed in America) was 4·774 cubic feet, as compared with 4·770 in 1890; while the illuminating power rose from 19·73 to 20·02 candles. There were 45·1 miles of main laid (an increase of 8·85 miles on the preceding year), of which 18·77 miles were of large, and 26·33 miles of small diameter. The advantage of putting down so much of the former kind of piping (from 6-inch upwards) was seen in the few complaints made of short supply during the period of heaviest consumption. The total quantity of gas manufactured was 3,391,887,000 cubic feet, of which 2,092,315,000 cubic feet are to be credited to the coal-gas works, and 1,299,572,000 cubic feet to the water-gas plant. Referring to the assistance rendered by the latter, Mr. Park says: "By reason of the leasing of some of the buildings, and by the addition of appliances, the Philadelphia Gas Improvement Company has it in its power to give us an increased supply. The wisdom of this grant by the city authorities was seen during the dark days of winter, when this Company, within a few hours, responded to demands for more gas; whereas it would have required days for stacks of the coal plant to have done the same thing. This ability of the water-gas plant to increase the supply also enabled us to get along during the fall and winter months without the Twenty-first Ward works, which have always been a source of expense when in operation, without corresponding profit. The total quantity of gas made since the erection of the works has been 64,269,572,000 cubic feet." The daily average production of gas was 9,292,841 cubic feet, against 9,073,958 cubic feet in 1890. The greatest make in 24 hours was 14,253,000 cubic feet, on Dec. 4, 1891; and the highest consumption in the same time, 16,196,000 cubic feet, on the 24th of that month. The total production of gas (3,391,887,000 cubic feet) is accounted for thus: Delivered to private consumers, 2,270,595,900 cubic feet; delivered to consumers, but not paid for, and in holders on Jan. 1, 1892, 522,687,800 cubic feet; public lighting (interior), 92,079,342 cubic feet; street lighting, 495,318,986 cubic feet; used on works, &c., 25,320,700 cubic feet—total, 3,406,002,728 cubic feet. Deducting stock delivered and not paid for, and stock on hand Jan. 1, 1891, 482,085,900 cubic feet, and adding the gas unaccounted for, 467,970,172 cubic feet, there is left the above-mentioned quantity of 3,391,887,000 cubic feet. The materials used in the manufacture and purification of gas were about 219,141 tons of coal, and 321,252 bushels of lime and "sponge." The coke and breeze made were 5,905,109 bushels, brought up to 6,161,199 bushels by the addition of the amount on hand (256,090 bushels). The total was disposed of as follows: Used under retorts, 2,002,845 bushels; used under boilers, in offices, &c., 436,576 bushels; coke sold, 3,005,163 bushels; breeze sold, 606,000 bushels—total, 6,050,584 bushels; leaving 110,615 bushels in hand on the 1st of January, 1892. The number of meters introduced was 5465; and of services, 10,515. These added to those in use brought up the total at the end of the year to 138,755 meters and 169,420 services. The total number of consumers on the books at the end of 1891 was 140,052; the total lights, 2,449,270; and the total length of mains, 1036 miles. The gross profits amounted to $1,441,308; being an increase of $110,289 over those realized in the preceding year.

The Dangers of Oil-Lamps.—A fire broke out in the workhouse at South Molton last Saturday week owing to the upsetting of an oil-lamp. Efforts were made to subdue the flames; but this was not accomplished until a portion of the building had been destroyed. An aged female, who was unable to effect her escape, was burnt to death. The others were rescued.——A paraffin lamp exploded on Monday of last week, in the house of David Roberts, a miner, residing at Seaham Harbour. Mrs. Roberts was in bed at the time; and three children were sleeping in the same room. The house was set on fire and a window blown out. While rescuing the children, Mrs. Roberts's dress caught fire; and the flames were communicated to the clothes of a child she was carrying. They were both dreadfully burnt.

THE METROPOLITAN WATER SUPPLY COMMISSION.

(*Lord* BALFOUR OF BURLEIGH, *Chairman; Sir* G. B. BRUCE, *Sir* A. GEIKIE, *Professor* DEWAR, *Dr.* W. OGLE, *Mr.* G. H. HILL, *and Mr.* J. MANSERGH, *Commissioners.*)

Twenty-fourth Day—Wednesday, Nov. 16.

When the Commission met this morning,

Dr. *E. Ray Lankester*, F.R.S., was examined. He divided the objectionable matters in water into two classes—those which made the water unsafe, in however small a degree, for drinking, and those which made it unpleasant to either of the sense-organs; and he stated that neither of those classes of matter was represented in the water of the Thames. He then dealt with the nature and action of the various bacteria in water; distinguishing between the harmless and the dangerous, and pointing out that their quantity was not an evidence of impurity. It would be possible to have one glass of water full of bacteria, and yet the water remain perfectly harmless; and another with but a small quantity of typhoid bacteria, and be deadly. One water might be sentimentally nasty, but not dangerous to human health; while the other would seem less offensive, yet be extremely dangerous—even fatal. Then those pathogenic bacteria were not poisonous at the moment of being swallowed; but after their entrance into the human body, they produced poison, in virtue of their growth along with the nutritive chemical processes within the body. With regard to the diseases communicable through water, they might be considered as limited to two—cholera and typhoid; and in this country the former also might be disregarded. As, however, it might come before them in the future, it would not be wise for a large community to have recourse to a source of water for drinking if there was any suspicion that, although safe from typhoid pollution, it might be tainted with cholera. At the same time, he should say that, if it were safe from typhoid, it would be safe from cholera. As far as his knowledge went, any means of preventing the transmission of the typhoid bacterium would also be sufficient protection against the transmission of the cholera bacillus. As to the sources of the water employed in the supply of London, it appeared to him that a very great point in their favour was the large volume in the rivers. Supposing that certain minute quantities of typhoid pollution were conveyed from the banks, there was every probability of this subsiding or being strained out in various ways without affecting the health of the consumers. As the water passed on, it was self-purified; leaving behind it such impurities as those which remained after subsidence. The system of filtration itself had proved to be very much more efficient than was anticipated when it was first adopted. There was apparently a remarkable process of purification going on in the filter-beds, rendering filtration perfect. At the same time, though they could detect the typhoid bacillus in water, and though it was to a great extent got rid of, they were ignorant of its history after it passed into the river; and he was most anxious to trace it to the end, and learn what its action was. In the river it clearly did not go on growing for ever, and he wished to know what became of it. He was conducting experiments with London water to ascertain this. But it could not be done quickly; and it was only in April last that he commenced the investigation. He could not, therefore, give any results; but he could say that, as far as he could ascertain, he believed a great deal of the immunity from the deleterious effects of the presence of typhoid bacillus was to be attributed to the ultimate subsidence of the bacteria to the mud at the bottom of the river, where probably great changes went on. In reply to further questions as to the communicability of typhoid fever by water, he said he accepted at present the opinion that, for water to be a source of danger in this respect, it must have had introduced into it the dejecta of persons suffering from the fever.

Examined by Professor DEWAR, witness said he agreed with the chemical evidence that the fact that a river water maintained itself fully aërated was a proof that in it one of the most important processes of purification was being effected; and, in further reply to the Professor, he said: I have used the most effective filter for securing bacterial matter; and I consider that I have established the absence of the typhoid bacillus. Bacteria have a certain amount of nutriment within them that enables them to multiply in absolutely still water; and they do so with great rapidity. That is why I say there is a difference between water as it is in the river and as it is studied in the laboratory. For example, if you take a litre of water from the river, it will contain only 73 bacteria colonies to each cubic centimetre. But in 24 hours those 73 bacteria colonies will have increased to something like half-a-million; whereas, if the water had remained in the river, there would have been no increase. Probably this is partly due to the continual subsidence of bacteria in large bodies of water; and the change of conditions may favour the growth. This circumstance very much vitiates the weight of observations which have not been made immediately upon the removal of the water from its natural source. The water should either be frozen, so as to prevent any change, or else it should be mixed at once with the reagents to be used in the experiments. Bacteria increase more rapidly in a comparatively pure filtered sample of water than in one already largely charged with bacteria. The addition of lime to the river water would very materially assist in its bacteriological purification. Having devoted special attention to the Oxford sewage effluent, I say that it is good from a bacteriological point of view. It does not contain more bacteria than many ditches which drain land, without any special relation to sewage farms, and run into the Thames. These ditches very often contain a larger proportion of bacteria than the river itself, owing, I suppose, to the water being in a smaller volume, and more stagnant. I have made experiments in the matter of irritating the river water in large tanks, so as to produce continuous motion, and therefore aëration. Some typhoid dejecta was introduced into the tanks; and it was found to be still present four days afterwards. But on the fifth day, it had entirely disappeared from the water in motion, though it was found still living in the sediment—out of reach, therefore, of the running water. I have come to the conclusion that increased care on the part of medical men in regard to the destruction of typhoid dejecta will tend greatly to diminish the danger of its getting into the Thames at all. Attention to the purification of sewage effluent is also desirable although, speaking generally, the Thames water could hardly be better for drinking purposes than it is at present.

By Dr. OGLE: If pure water were accidentally polluted by typhoid matter, and that water were delivered at once, without previous storeage, it would be more likely to produce an outbreak of typhoid fever than would the pollution of a comparatively impure water that had been stored. In the case of the Caterham outbreak, the water was of exceptional purity, and was not filtered or stored before delivery. The typhoid bacilli multiply with great rapidity, even in distilled water. The dejecta of one single patient was sufficient, in the Caterham case, to contaminate an immense quantity of water; and a similar pollution of the Thames would have a like effect, if the water were not filtered before delivery.

Mr. MANSERGH: Do you consider that the Thames is a river specially suitable for a water supply, owing to its having plenty of pools for subsidence, and weirs where the water is tossed about and aërated.

Witness: Yes; compared with a sluggish stream or a highly-locked river without weirs, like the Seine.

Mr. HILL: Assuming that reservoirs were made in the higher reaches of the Thames, so as to store the best of the flood-water in time of flood, and keep it till the dry season came on, would it be best to deliver it into the river again?

Witness: I think it would be very desirable to turn such water into the river after it had been stored.

Do you not think water of that kind, stored for a long time during the summer months, would be affected and deteriorated by the temperature?—No; not if it is kept free from pollution, and vegetation is encouraged.

Mr. HILL: As an engineer, I know cases of water being collected from mountain lands and stored in reservoirs, and becoming at certain times and under certain conditions, unfit for use.

Sir A. GEIKIE: Is it possible, or probable, that any such contamination as Thames water is liable to from the sewage that comes into it would have any deleterious effect on the people drinking it?

Witness: The danger is very remote.

Have you ever made a comparison of the water coming out of a newly-constructed reservoir with that coming from a comparatively old one?—No.

In reply to the CHAIRMAN, witness said that in Paris two classes of water were supplied—one for drinking, and the other for general sanitary purposes. Sometimes the drinking water ran short; and then the second-class water was turned, without being filtered, into the mains conveying the drinking water. A deputation from the Municipality of Paris had recently been in London to study the English system of filtering, with a view to its adoption.

Dr. *Klein*, F.R.S., said he had made a study of water, and of the living organisms existing therein. He produced a report he had made to the London County Council on the character of the bacteria found in London water. In no case had he come across any pathogenic species, or any species that had produced in the animals experimented on—guinea-pigs, mice, and rabbits—any definite pathogenic action. To search water for one particular bacterium was, however, like looking for a needle in a bottle of hay; and his failure to discover the cholera, typhoid, or diphtheria bacteria, could not be taken as absolute proof that they were not there. Even if they were entirely absent during the six weeks over which his observations extended, it would not follow that they would also be absent during the other 46 weeks of the year. He had never actually seen the diphtheria bacillus in water; but he saw no reason why it should not be there. He had never failed to find bacilli in any spring or other natural water that he had examined for the purpose. It was possible that, after filtration, and when the water had passed into the mains, the organisms reappeared and multiplied.

Sir A. GEIKIE: Does the presence of such bacteria as you have found in the London water disqualify it from being suitable for the community?

Witness: So far as the presence of the particular organisms I discovered are concerned, I should certainly say not; but, as a sanitarian, I should say that, in a variety of ways, there is danger connected with such a supply. In the first place, I do not see how any open filter can really intercept all bacterial matter, particularly phosphorescent bacteria.

Witness here produced a number of slides containing magnified representations of the principal bacilli.

In reply to Sir A. GEIKIE, witness said, as he had not tested the point himself, he accepted without hesitation Dr. Ray Lankester's statement that the filters were generally successful in intercepting about 98 per cent. of the organisms in the water.

Sir A. GEIKIE: Therefore, although not absolutely perfect, the filtration produces a very great diminution of risk?

Witness: Unquestionably; but if you introduce into the water 100 typhoid bacilli, and if 90 are intercepted by the filter and 10 pass them, you have the risk that those 10 may do mischief.

From a study of the health of London for the last quarter of a century, would you say, *à priori*, that there is any danger in its water supply?—I could not answer that question, as I have not specially studied it. To my mind, no filtration is reliable to do away with all risks. It may diminish them; but I do not see how one can claim for any system of filtration that it supplies us with an absolute safeguard.

Can you, as a matter of fact, get absolute security in any form of water supply?—That is not a point on which I should like to say anything positive. I am not specially acquainted with the different modes in which water is supplied to towns other than London; and I do not know what the statistics are. I should say, in regard to any water supply coming into contact at many points with contamination, that *à priori* there is no method of securing absolute safety short of boiling it. I would not say that any water that may be exposed at one time or another to contamination is absolutely safe. I have not examined any deep-well water, but I have several of the aërated waters that are used so largely by the public; and the results in some instances have been very striking. I may mention one water in particular that is advertised as being absolutely pure compared with London water—that was London ditch water, of course. In one examination of it, I found 21 bacteria colonies; and in another, 41 colonies. I examined

the West Middlesex Company's water on the same day, and found it purer than the aërated water in question, and containing a smaller number of colonies. The effects of the introduction of pathogenic bacteria into the system differ according to the various species and susceptibilities of the animals experimented upon. For instance, bacilli of anthrax introduced into a guinea-pig would set up fatal anthrax; whereas 10 or 100 times this number would be required to produce it in a rabbit. Something also depends upon whether you are using a new or an old culture, as the latter is less virulent.

Knowing as you do the proportion of pathogenic bacteria required to produce disease, do you think the water of the Thames is ever sufficiently charged with those bacteria to be deleterious?—I am not aware of any facts that will tell me how many typhoid bacilli will be required to produce disease. There are no data as to the dose of pathogenic bacteria necessary to set up disease in human beings; but I have already stated that it has been shown that bacilli have produced fatal anthrax in a guinea-pig.

In answer to Professor DEWAR, witness said that, even if only 2 per cent. of the bacteria passed the filters, he would try to guard against that. Thames water was obviously exposed to danger. It was a receptacle for a variety of means of contamination; and, however much the number of organisms introduced originally might be reduced, there would still remain a certain proportion capable of producing harm. He doubted whether storeage prior to filtration would be an advantage. He should think it would be rather the reverse, as it would give the bacteria the opportunity of multiplying. He admitted that there were instances of water fouled with cholera dejecta producing that disease; but, as to the proof of such dejecta, when passed into water, spreading infection, there was really not sufficient. As to whether or not the particular bacillus which had been associated with the cholera was the cause of the disease, he could not say. The evidence of its being the active cause was considerable, but the point was not well established; and he entertained a similar reservation with regard to the typhoid bacillus.

In reply to Dr. OGLE, witness mentioned that the samples of water given to him for examination were taken partly from the river and partly from stand-pipes in the streets of London; and he said it was quite possible that the microbes which he found in the water might have come in after it had passed through the filters. As to the alleged production or spread of disease by water, he acknowledged that it had not been proved that diphtheria had been so propagated, but that it had again and again been proved to be conveyed by milk direct from the cow. Neither was there any knowledge of erysipelas being communicated by water; they had no facts to point to this being the case.

Asked by the CHAIRMAN if he had anything to add, witness reminded the Commission that the chemical examination of water was, from a sanitary point of view, he would not say of no value, but of very limited value. Water which was pure in the sense spoken of by chemists might be charged with infection.

The CHAIRMAN remarked that the Commission were well aware of the difference of views.

Dr. *Percy Frankland* submitted comparisons of analyses of filtered water from the Thames, the Lea, and Loch Katrine; and he showed that the organic matter in each was about the same in quantity, or, if anything, rather less in the Lea water than in the others. As to the quality of the matter, that in Loch Katrine was almost exclusively of vegetable origin; whereas in the case of the rivers there was necessarily an amount of impurity of animal origin. But the quantity of organic matter in the London water was by no means in excess. Asked if he laid any stress upon the size of the storeage reservoirs—holding, for instance, that the larger gave better results than the smaller—he pointed out that, if the reservoirs were not large, the water would not remain in them for any considerable period, and the subsidence would be reduced. There was a striking diminution of suspended organisms during storeage in large reservoirs. Questioned next as to the relative numbers of micro-organisms in the water after and before filtration, he stated that, in the summer experiments, the numbers obtained in the filtered water were independent of those in the unfiltered; and this should show that the filtration was going on so perfectly that only a very small proportion indeed of the organisms could be passing through, and could not alter materially the number present in the filtered water, in which there seemed to be some in any case. In fact, the great majority of the micro-organisms in filtered water he attributed to post-filtration sources; the material of which the filter-bed was composed being charged with micro-organisms. As to new filter-beds not working so well as old ones, he had observed that the former settled down to their work generally in four or five days, and sometimes in two or three. There were several conditions which affected the freedom of the filtered water from micro-organisms—such as storeage, rate of filtering, renewal of the filter-beds, and thickness of the sand layer; and he observed that there was a general tendency now to reduce the rate of filtration, and increase the area. Asked next what was the effect of storing large quantities of water in reservoirs—not the small storeage reservoirs of the Companies—he mentioned that he had not had any experience of stored water in circumstances like that of the Thames; but he had seen water collected from cultivated land, such as at Dundee. There was certainly no disagreeable smell, or anything of the kind there; and he had not heard of any complaint, though the reservoirs were not cleaned out for years together. It was upland surface water, but it passed over cultivated ground; and, as a matter of fact, it contained very much more organic matter than did the Thames water in times of flood, and was distinctly more polluted by animal matter. Increased purifying area was of very much more importance than additional depth. Slower filtration was what was most wanted.

Professor DEWAR: You say it is obvious that, by employing suitable storeage, much of the flood water that is at present wasted might be turned to useful account?

Witness: Of course, there are occasions when the flood water would not be suitable, and it would not be desirable to store it. But a good deal of it could be utilized, and stored efficiently. I can conceive of stored water being in a better hygienic condition than that coming down the river. In any case, I should recommend the stored water to be filtered.

Asked if he agreed with the statement that the present intakes of the Water Companies were just as good as would be obtained by going higher up the river, witness said he had not sufficient data to give an absolute answer to the question; but he thought that, on an average, the water taken now was just as good as could be had at any other part of the river.

The Commission shortly afterwards adjourned till the next day.

JOHANNESBURG WATER SUPPLY.

The position of the water supply of Johannesburg was set forth at a meeting of shareholders of the Johannesburg Water-Works, Estate, and Exploration Company, Limited, held last Wednesday at Winchester House, E.C. The meeting was convened by the London Agents, Messrs. Davis and Soper; the last-named gentleman presiding. In opening the proceedings, he stated that the meeting was only an informal gathering of the British shareholders, held for the purpose of giving them an opportunity of expressing their opinion as to any matter affecting the interests of the Company. The report and accounts, which showed the satisfactory condition and good prospects of the undertaking, had been circulated; and, unless any shareholders had questions to ask, he did not propose to offer any observations. Sir J. Sivewright (Commissioner of Crown Lands and Public Works for Cape Colony), the founder of the Company, then addressed the meeting. He said it was the first Company with which he associated himself on his return to South Africa after retiring from the Government service of the Cape Colony; and if he were asked to mention any undertaking with which, despite his official position as a Minister of the Crown in the Cape, he would still like to have his name associated, he would put none before the Johannesburg Water-Works, Estate, and Exploration Company. He knew that, in the past, efforts had been made to "throw a little mud" at some of those who were in the Company; and their *bona fides* in certain of the agreements they had entered into had been questioned, as well as some of the steps which the Directors—and he was Chairman of the Company as well as Managing-Director at that time—had felt called upon to take He must, however, say that, with all his experience of the past few years, had he to go back, he did not know of one single act that he would not be prepared to do over again, and stand by it. Mr. Barnato, when he faced the London shareholders at that time, told them the property was going to be four times its then value. He turned out only half a prophet; for he (the speaker) was informed, when he entered the room, that the market price put the value at more than Mr. Barnato had stated. He (Sir J. Sivewright) held strongly the opinion, as the largest shareholder in the Company—possessing, as he did, about 4000 shares—that, if they had confidence in the Directors, as he had, it would be an unwise thing to transfer the responsible management from Johannesburg to this country. There they were face to face with the work, with the local conditions they had to encounter, and everything which contributed to the success of the country; and it would be a great mistake to remove the management, even to the City of London. With regard to the quality of the water, when tested originally by the late Dr. Tidy, it was pronounced to be singularly pure; and though it had been interfered with by railway works, any defect resulting therefrom had been remedied, and in his opinion the water was now equal to any supplied in the civilized world. As to quantity, grave doubt was expressed at the outset whether there would be water enough to supply Johannesburg. But if he were asked to-day whether he thought they would have sufficient water to supply the Johannesburg of the future, he should be bound to answer in the negative, because he had such a belief in its future that he could not think the Company's springs would be adequate. When the Company was projected, it was little dreamt that in 1892 they would be called upon to supply a population of little short of 40,000. He inspected the springs two months ago; and, although it was at the worst period of the year, he was free to assert that they were considerably stronger than when he visited them five years since. Not only was that his opinion, but the Manager (Mr. Andrews), who was a most capable man, after making very careful measurement, assured him that he had ample water for the domestic requirements of a population of 100,000 inhabitants. Now that reservoirs were being completed, an arrangement would be in force in future which would dispense almost entirely with direct pumping; and he had little doubt that the complaints of short supply which were heard would disappear, until, at all events, they got pretty near to the limit fixed by the Manager. The bogey of a rival company had been hanging over their heads; but he thought the shareholders need not be alarmed about that. The day would come when more water would be required for Johannesburg, when they would see a town of more than 100,000 population; but it was a long way off yet. Their Company was in possession; and this in South Africa counted for quite nine points of the law, even if it did not go farther. He believed that, so long as they gave a fair service and remained a fairly popular Company, they would, at any rate, have the refusal of any additional source of supply. He concluded by again expressing his entire belief in the undertaking. Mr. Barnato followed, and gave a few facts relating to the internal working of the Company, which he characterized as one of the most prosperous in Johannesburg. Leaving out the question of water, the Company's reversionary rights were, he said, worth the whole of their capital; while they supplied 40,000 inhabitants with water, and had an income from ground rents of something like £8000 a year. The balance-sheet this year showed a profit of about £20,000; but the report was only made up to March 31, since which time the revenue had been increasing. At the close of Mr. Barnato's remarks, questions were invited. As there was no response, the proceedings closed with complimentary votes of thanks.

The Gas-Works Purchase Question at Rhyl.—The Rhyl Improvement Commissioners have accepted an offer of a loan of £35,000 for the purchase of the gas-works, at 3½ per cent. interest, payable in 30 years by annual instalments of principal and interest combined. This will mean an annual charge on the town of £1903.

METROPOLIS WATER SUPPLY.

The Quality of the Water in October.

The returns furnished to the Registrar-General by the London Water Companies as to the water supply of the Metropolis during the past month, show that the average daily supply was 182,601,846 gallons, as compared with 179,951,481 gallons in the corresponding month of 1891. The number of services being 788,787, the rate was 231 gallons to each service. Of the entire bulk of water sent out, 93,255,657 gallons were drawn from the Thames, and 89,346,189 gallons from the Lea and other sources.

Reporting upon the quality of the supply, Dr. E. Frankland said: "Taking the average amount of organic impurity contained in a given volume of the Kent Company's water during the nine years ending December, 1876, as unity, the proportional amount contained in an equal volume of water supplied by each of the Metropolitan Water Companies and by the Tottenham Local Board of Health was: Kent, 0·9; Tottenham, 1·3; Colne Valley, 1·4; East London (deep well), 2; New River, 2·3; East London (river supply), 3·1; Chelsea, 3·7; Grand Junction, 3·8; West Middlesex and Lambeth, 3·9; and Southwark, 4·1. The raw river waters gave the following numbers: New River cut, 1·9; the Lea at the East London Company's intake, 4; and the Thames at Hampton, 4·9. The Thames at Hampton was, both chemically and bacterially, in rather a bad condition, owing to the autumn decay of vegetation. It was chemically 22 per cent., and bacterially no less than 144 per cent. worse than in September. Nevertheless it was, in every case, efficiently filtered before delivery; In comparison with the September samples, the chemical deterioration of the water delivered by the Thames Companies varied from 19 to 42 per cent.; while the bacteriological deterioration was not excessive in any case, and the Chelsea and West Middlesex Companies were actually sending out water of improved quality, as regards microbes, on the day when my samples were collected. The untreated water taken chiefly from the Lea by the New River Company had, neither chemically nor bacterially, suffered any deterioration whatever. At the intake of the East London Company, on the other hand, there was a chemical improvement of 5 per cent., but a bacterial deterioration of 89 per cent. Both waters were efficiently filtered before delivery; but the New River Company's supply was chemically 21 per cent., and that of the East London Company 41 per cent., inferior to the respective samples drawn in September. Nevertheless, both waters were chemically superior to any of the Thames-derived supplies. Bacterially, both samples exhibited deterioration, but not to any serious extent. The deep-well waters of the Kent, Colne Valley, and Tottenham Local Board of Health were of excellent quality for dietetic use; that of the Kent Company being especially distinguished for its very high degree of organic purity. The water from the Waltham Abbey well of the East London Company contained rather more organic matter (entirely of vegetable origin) than usual, and it was very slightly turbid; but in other respects it was of good quality. The Colne Valley Company's water, having been softened before delivery, was rendered suitable for washing. The waters of the Kent and Colne Valley Water Companies were clear and bright without filtration, but that of the Tottenham Board of Health contained a few particles of rust of iron. Seen through a stratum 2 feet deep, the Kent and Colne Valley Companies' waters were clear and colourless; the Tottenham, colourless and very slightly turbid; and the East London Company's deep-well water, nearly colourless and very slightly turbid. The waters derived from the Lea were, as delivered, clear and very pale yellow; while those from the Thames were all clear and pale yellow. The crude river waters presented the following appearances: New River cut, turbid and very pale yellow; the Lea at the East London Company's intake, turbid and pale yellow; and the Thames at Hampton, turbid and yellow. The bacteriological examination of the waters as they left the filters of the various Companies, by Dr. Koch's process of gelatine plate culture, gave the following results: One cubic centimetre of each water collected on Oct. 17, 18, 19, and 22 developed the following numbers of colonies of microbes: Kent (from delivery-shaft of pump), 3; West Middlesex, 3; Chelsea, 5; Grand Junction, 12; New River, 13; East London, 22; Southwark (filter No. 1), 26; Do. (filter No. 3), 14; and Lambeth, 43. Of the raw river waters, the New River cut developed 737; the Thames at Hampton, 2316; and the Lea at the East London Company's intake, 3684 colonies of microbes per cubic centimetre."

Messrs. Crookes and Odling, in the course of their report to the Official Water Examiner for the Metropolis (General A. de Courcy Scott) on the quality of the water supplied by the London Water Companies during the past month, as shown by samples taken daily for analysis, state that it continued to be excellent; and it was found not to differ appreciably in character from that of the preceding month, or materially from the supply of the past six months inclusive, taken as a whole. Of the entire rainfall in the month, amounting at Oxford to a little over 3 inches, fully 2½ inches fell during the last five days of the month, with the result of bringing the river into flood, but not affecting the character of the then supply. The entire series of 182 samples examined were found to be well-filtered, clear, and bright; and their degree of colour-tint to be low for the season of the year. The following table of the results furnished by the Thames-derived supply, taken for illustration, shows the smallness of the extent of monthly variation at present noticeable in the amounts of organic matter present in the water; the excess of organic carbon in the October supply above the mean for the six months' supply, or 0·01 part in 100,000 parts of the water, being quite infinitesimal:—

Thames Supply.	Ratio of Brown to Blue Tint. Means.	Oxygen required for Oxidation. Means.	Organic Carbon per 100,000 Parts. Means.	Organic Carbon per 100,000 Parts. Maxima.
Past six months	10·4 : 20	0·039	0·117	0·155
September	15·5 : 20	0·042	0·118	0·145
October	15·0 : 20	0·047	0·127	0·155

NOTES FROM SCOTLAND.

From Our Own Correspondent.

Saturday.

The Corporation of Aberdeen, at the recent election, appointed Mr. Bisset to be the City Treasurer. Mr. Bisset is understood to be a representative particularly of the working classes; and he himself, in an address to the Trades Council, stated that when he was nominated for the office it was because, there having been loud demands for economy raised by those with whom he worked, the best thing that could be done in the circumstances was to put one of their number in charge of the purse strings. The address was on the subject of the finances of the town; and the brand-new Treasurer very instructively took this early opportunity of making his supporters understand that he has no expectation of being able to reduce the expenditure of the city, but that, on the contrary, it must increase. Speaking of the Gas Department of the Corporation, he stated that the annuities for which they were liable were valued at £163,947, and they had borrowed on mortgage, £45,292; making the total indebtedness of the city, under the Gas Acts, £209,240. In the Gas Department account they had a very good illustration of the evil of issuing what really was "stock." In 1872, the Town Council took over the Gas Company, the shares of which had £2 10s. paid up. A dividend of 10 per cent. was being paid by the Company, which made the shares sell at £5. When the town took them over, they issued annuities, and gave 5s. per annum on the £2 10s. The sum set down in the accounts as the value of the works in 1872 was £114,933; but to meet the annuities, an annual sum of £6500 was required. These annuities were irredeemable, and had to be bought in the market for what they could be got at; and the longer they were in being bought up, the higher they would go—at least, so long as the price of money went down. They had redeemed them to the value of £30,500; but still, to meet the annual charge, a sum of £5376 was required. The present price of what originally were shares with £2 10s. paid, was quoted, in the shape of the value of the annuity, at £7 13s. 9d.

The Wishaw Corporation Gas-Works have been extended by the re-building of the retort-house and the erection of a new gasholder. In the new retort-house, a bench of 24 retorts, from the design of Mr. G. R. Hislop, of Paisley, has been constructed. The new gasholder is of 88,000 cubic feet capacity. The extensions were required because of the rapid increase of the gas consumption, which, for the past two years, was at the rate of 2½ million cubic feet a year.

Among the joint-stock companies which have been registered in Edinburgh this week, was the Murray and Macintyre Patent Gas Kiln Company, Limited, which has been formed in Glasgow to acquire patent rights in connection with the manufacture and working of gas kilns, muffles, gas, and gas plant, and to carry on business as gas and gas plant manufacturers. The capital of the Company is £3000, in shares of £20 each. Two-thirds of the capital is ordinary; and the remaining one-third is preference 10 per cent. stock.

The aim of the Dundee Water Commission, to have a duplicate water service from Lintrathen Loch to the city, has now been accomplished. Two or three years ago, the main was duplicated from the Loch to Pitnappie; and this ensured an efficient service through the valley of the Isla, where the pressure was most severe, and the greater number of the fractures in the original main occurred. Extensions of the area of supply made it desirable to continue the duplication of the main right on to the city; and the work has now been completed. Mr. Baxter, the Engineer, reported to the Commissioners on Thursday that the water had been running full, for the greater portion of the distance covered by the new main, for a fortnight; and that he had detected no flaw either in the pipes or the joints. The remaining portion of the new main would be tested in the same way. Although Mr. Baxter could not, as yet, report what the total expenditure had been, he was able to state that it would be within the estimate of £29,000.

A serious leakage has for some time existed in the embankment of the reservoir from which the water supply of Dunoon is derived. The mischief has extended very much of late; and at present it is calculated that as much as 66,000 gallons of water is lost every day. The Police Commissioners have made arrangements for the supply of the burgh from a diverted stream; and they will then empty the reservoir for the purpose of inspection and repair.

An extraordinary obstruction to the water supply of Burntisland has been discovered, in connection with the process of cleansing of the mains. In two instances deposits of lead, one weighing 10 lbs. and the other 21 lbs., were found; but this is easily understood. What is difficult to account for is, how a piece of wood, about 2½ feet long and several inches square, had been allowed to get into and to remain in the pipe when it was laid. The obstruction had been in the pipe for 17 years; and its presence sufficiently accounts for the ineffective nature of the supply.

Dwellers in cities are so accustomed to have their water supply brought to them, that they are inclined to regard the service as being a thing which somebody or other should do for them as a matter of course, and to accept it without any shadow of gratitude. Those who dwell in rural districts, and in sparsely populated places, have, however, more difficulty in obtaining a water supply than have the residents of towns. This arises, in part, from the want, till recently, of the necessary organization for the procuring and managing of the the works; but that is a disadvantage which has been removed by the creation of County Councils. Since they came into existence, much has been done by them in the way of improving the lot of the people; and not the least of the good things they have done, has been the control of the water supply. In this connection, work of a parochial nature falls to every one of the Councils; but a few have a more serious task before them in regard to the supply of water to wide areas, where a number of small townships exist. Such questions, for instance, are before the County Councils of Linlithgowshire and Stirlingshire; but neither of them have yet got a settled scheme. In Lanarkshire, the Council has been more energetic, and have secured parliamentary powers for the introduction of a general supply to a large portion of the Middle Ward. The scheme which has been adopted was prepared by Messrs. Leslie and Reid, of Edinburgh; and it consists of the construction of a reservoir of 600 million gallons

capacity at High Plewlands, 800 feet above sea level, to impound the waters of the Glengavel Stream. From the reservoir, there will be a single main till Strathaven is reached, where the water will be filtered, and then led by a series of distributing mains to the different places in the district. The cost of the scheme is estimated at over £200,000; and the daily yield of water, at 2½ million gallons. In connection with the procuring of the Act, it is worthy of mention that, when the District Committee began to investigate the subject, they found that neither they nor the County Council had power to promote Bills in Parliament; and the only way the district could obtain the boon of a water supply, was through the public spirit of a number of the Councillors, who, at the risk of having to pay the parliamentary costs out of their own pocket, became individually liable for the outlay. Of course, the Act having become law, they are relieved of the liability—provision being made in the usual way for the defraying of all the charges connected with its promotion.

On the 15th inst., I gave the results of the year's working of the Cairntable Gas Coal Company, the information having come to me through one of the ordinary channels. It turns out that, while the figures are correct, the reason given for the decrease in revenue is not the one which the Directors advance in their report. What they say is that it "is attributable to reduced prices for common coal and to extra expense in driving mines to maintain the output of cannel, which very much increased the average cost of working." In another part of the report they say: "A portion of the output of gas coal has been sold at good prices; but the demand has fallen off and lower prices may have to be taken." This report was only issued last Wednesday; and so the information published by me a fortnight ago must have originated with some ingenious person who set himself to write a report for the Directors. It looks as if he was someone connected with the Company, because his figures were rightly given; and if the Directors wish to deal with him, they should have little difficulty in finding him out.

CURRENT SALES OF GAS PRODUCTS.

LIVERPOOL, *Nov.* 26.

Sulphate of Ammonia.—The market and general position are unchanged; and if the demand from consumers is not quite so active, it is merely because the needs are temporarily satisfied. The parcels, however, which come on the market are well competed for; and, in one or two instances, somewhat above current quotations have been realized. With rather more offering at Leith, £10 1s. 3d. has been accepted by makers; otherwise the value at Hull and Liverpool is still £10 2s. 6d. Nitrate shows no new feature. Slightly lower prices were accepted for cargoes near at hand, the market closing quiet but steady. The value on spot remains at 9s.

LONDON, *Nov.* 26.

Tar Products.—A considerable amount of business is reported in benzols; and the market may be said to be better in both 50's and 90's. Large shipments of pitch are being made; and this article, contrary to everybody's expectation, continues firm, notwithstanding the increased production. Creosote and tar oils are in poor request; very little new business being done in them. Anthracene appears to be neglected; but makers decline to accept lower prices. Carbolic acid is in good demand, with a tendency to increased value. Prices are as follows: Tar, 10s. to 11s. nominal. Pitch, 28s. Benzols, 90's, 1s. 6½d.; 50's, 1s. 3½d. Toluol, 1s. 2½d. Solvent naphtha, 1s. 1½d. Crude benzol naphtha, 30 per cent., 7½d. Creosote, 1¼d. Creosote salts, 18s. Pressed naphthalene, 42s. 6d. Carbolic acid, 60's, 1s. 3½d.; 70's, 1s. 8d.; crystals, 5½d. Cresols, 10½d. Anthracene, 30 per cent., "A," 11d. nominal; "B," 8½d. nominal.

Sulphate of Ammonia.—Large quantities have changed hands at £10 2s. 6d., less 3½ per cent. Heavy shipments are being made. Makers' stocks are low; and, with the improved value of nitrate, sulphate is likely to be dearer in a few weeks. Gas liquor is quoted at 6s. to 7s. per ton.

COAL TRADE REPORTS.

Lancashire Coal Trade.—Only a very slow business is reported in all descriptions of fuel; and round coal, both in the better qualities and the lower descriptions, is hanging upon the market, with a weakening tendency, if anything, in prices, although there is no actually quotable change on late rates. The exceptional mildness of the season is, of course, considerably restricting requirements for domestic purposes; while as regards general manufacturing consumption, the continued depressed condition of the iron and other coal-using industries necessarily results in only very limited demand in this direction. The shipping trade also continues but quiet, with low prices ruling at the ports on the Mersey. At the pit mouth, best Wigan Arley coals are readily obtainable at 12s. to 12s. 6d.; Pemberton four-feet and second qualities of Arley, 10s. to 10s. 6d.; common house-fire coals, about 8s. 6d. to 9s.; steam and forge coals, 7s. to 7s. 6d. per ton; and good qualities of steam coal, 8s. 6d. to 8s. 9d. per ton. The gradually enlarging area of the mill stoppages in Lancashire, necessarily makes itself felt on the demand for engine fuel; and surplus quantities, which would otherwise have gone into consumption in the cotton and manufacturing districts, are being pushed upon the market, in many cases at very low figures. Quoted rates are, however, fairly maintained, burgy still ranging from 6s. up to 6s. 6d.; best slack, about 5s.; medium sorts, from 3s. 9d. to 4s. 3d.; and common, about 3s. 3d. per ton.

Northern Coal Trade.—The demand for coal has of late fluctuated; and prices, on the whole, have slightly fallen. Best Northumbrian coal naturally feels the falling off in the demand for the Baltic, and now about 9s. per ton is the current rate for it; while second qualities are about 9d. per ton less, and small steam coal is fairly steady at from 3s. 9d. to 4s. per ton. Household coal is only very quiet for the season; and manufacturing coal is very dull, contracts being accepted at reduced prices for next year. In gas coal, there is now naturally more demand to report; and the output is very large, and is generally well taken up. The price in the open market varies from 7s. to 8s. per ton f.o.b.; but there is gas coal obtainable at less than the lowest of these figures, and for one or two kinds as hig as 8s. 6d. per ton is asked. One or two contracts for next year's supplies have been decided on in the last few days for local companies; and though the prices differ considerably, yet generally there is a decrease of from 1s. to 1s. 6d. per ton on the prices that are paid under the present contracts. Blast furnace coke is in very good request, there being a large production; but the number of blast furnaces in operation has been sufficient to take up the output. The price of best Durham coke, delivered at the local furnaces, is about 12s. 3d. per ton; and for shipment, the usual price asked is about 15s. per ton. Gas coke varies in price. For prompt shipment it is firm, and as high as 9s. 6d. per ton is asked; but for contracts for delivery over next year to the local cement works, it is expected that the prices will vary from 6s. 9d. to 7s. per ton.

Scotch Coal Trade.—After weeks of dulness, prices in Scotland show a tendency to give way, particularly for the better sorts; and this looks as if manufacturers were disposed to be as economical as possible, and to go in for secondary qualities. The demand for shipping has slackened very much, though the quantity of coal sent abroad on old contracts is still considerably above what it was last year. In the Lothians, the men, after an interview between representatives of themselves and of the coalowners, have consented to a reduction of 10 per cent. on their wages, which is the second 10 per cent. reduction they have submitted to this year. Everything points to a further reduction in prices. The quotations given are: Main, 6s. 9d.; ell, 8s. to 8s. 3d.; splint, 7s. 6d. to 7s. 9d.; and steam, 9s. 3d. to 9s. 6d. per ton. The shipments for the week were 148,922 tons—a decrease of 17,360 tons as compared with the preceding six days, but an increase of 23,094 tons upon the shipments in the corresponding week of last year. For the year to date, the shipments have been 6,890,024 tons—an increase upon the figures for the same period of last year of 903,069 tons.

Newhaven and Seaford Water Company.—The annual meeting of this Company was held last Tuesday. A gradual progress in the business was shown by the report and accounts presented. The profit for the year amounted to £662, and the sum available for division was £657. From this a dividend at the rate of 4 per cent. per annum (free of income-tax) was declared.

The British Water Gas Company.—Suggestions have been made in the correspondence columns of the *Yorkshire Post* that the shareholders of this Company should take combined action, in order that their views may be properly represented at the annual meeting to be held on the 3rd prox. The result is that a preliminary meeting is to be held this week, to arrange for the recommendation of a Committee of Investigation.

Extraordinary Fatal Accident at the Basford Works of the Nottingham Corporation.—The Borough Coroner of Nottingham held an inquest last Tuesday concerning the death of Robert Allcock, aged 43, which occurred at the Basford Gas-Works on the previous Sunday night. The evidence given by William King showed that he was helping deceased to remove the lid of a cistern. Immediately inside the cistern was a bucket of water into which ran a pipe, through which ammoniacal liquor flowed. The bucket was placed there to seal the pipe; so that the stench arising from the liquor should be kept down. Deceased, thinking something was wrong with the pipe, told witness to remove the bucket, which he did. He then looked at the pipe, and made it all right, and witness put back the bucket. Allcock was not satisfied with the way the bucket was replaced, and attempted to see to it himself. He stooped down into the cistern; but at this point witness became so overpowered with the fumes arising from the liquor, owing to the bucket being removed, that he was rendered unconscious. Herbert Place stated that he was standing by the cistern when deceased stooped down to see to the bucket. As soon as the latter was removed, Allcock fell into the cistern (which contained about 4 feet of water), being overpowered by the fumes arising from the liquor. He endeavoured to get deceased out; but was unable to do so owing to the strength of the gas which came through the pipe, and which continued to rise until the bucket had been put into position again. The jury returned a verdict of "Accidental death."

Portsmouth Water-Works Company.—The half-yearly meeting of this Company was held last Thursday week. The Directors reported that the accounts for the six months ending Sept. 30 last showed an available balance of £14,902, out of which they recommended the payment of the full statutory dividends, which, after the usual deductions, would leave a balance of about £1071 to be carried forward. During the half year 927 mains had been laid in new roads, and 269 additional premises had been connected. The total number of premises now supplied by the Company was 34,810; and the average daily supply for all purposes had been 5,435,000 gallons. The Directors mentioned that they had not received any further communication from the Committee of the Portsmouth Corporation since the last half-yearly meeting relative to their desire to purchase the Company's undertaking. The Chairman (Mr. W. Grant) in moving the adoption of the report, said the shareholders would notice that the water-rental for the half year had increased by £359, as compared with the corresponding period of last year. On the other hand, the expenditure had been somewhat greater, which was chiefly due to the fact that, during the half year, extensive and extraordinary repairs to the engines, which had been carried out previously, had been paid for. They would all agree with him that money was well spent which was disbursed in maintaining the plant and engines in the highest state of efficiency. There was one other subject upon which he would say a few words—viz., the overtures set on foot by the Committee appointed by the Corporation with a view to the acquisition of the Company's undertaking. The Directors had received no communications from the Committee during the past six months; but any further proposals which came before them they would consider fairly and carefully. The Corporation must, however, recollect that the shareholders possessed in the Company a splendid property, the profits of which were increasing every year, and should not therefore expect that they would part with their property and interests without full compensation. Colonel Owen seconded the motion, which was unanimously carried.

Electric Lighting for Kingston.—The Kingston Town Council resolved last Thursday to obtain a report from Mr. W. H. Preece as to the establishment of a system of electric lighting in the borough.

New Water-Works for Redruth.—The Redruth Local Board have had a report submitted to them by Mr. B. Nicholls, C.E., of Birmingham, on the water supply of the town, in which he recommends the construction of works estimated to cost £9902.

Sale of the Pateley Bridge Gas-Works.—The property of the Pateley Bridge Gas Company—comprising gas-works, meters, mains, workman's cottage, a villa residence, and other buildings—was sold last Saturday week, for £2350, to the North-Eastern Railway Company.

Electric Lighting in the City of London.—At the meeting of the Commissioners of Sewers of the City of London last Tuesday, a letter was received from the City of London Electric Lighting Company relative to the progress made in lighting the City by electricity. They stated that, out of 515 arc lamps contracted for in the principal streets, 409 had been supplied—some of them three months before the contract time. Of the remainder, the positions of 44 had not yet been definitely fixed; but the rest would be completed as soon as the operations retarding them, for which they were not responsible, such as the repaving of streets, were finished. They were now prepared to go on with the erection of the incandescent lamps in the smaller streets.

Singapore Gas Company, Limited.—The Directors of this Company, in the report for the half year ending June 30 last, which they will present to the proprietors at the extraordinary general meeting to be held to-morrow, state that, notwithstanding the extreme depression of trade in Singapore, and the serious increase in the loss on exchange, the business of the Company has been fairly well maintained. There have been 27 additional public lamps erected, and the number of private consumers has slightly increased. The sales of residuals, however, exhibit some falling off, on account of the Manager being obliged to reduce the price of tar, owing to the great competition with tar importers. The amounts due continue to be efficiently collected; and the works and plant, including the mains and services, have been kept in thoroughly sound and working order. The accounts accompanying the report show an available balance of £1368, out of which the Directors recommend the declaration of a dividend at the rate of 4 per cent. per annum, less income-tax; carrying forward a balance of £123.

Sales of Stock and Shares.—At Maidstone last Thursday week, a number of shares in several local undertakings were disposed of by auction. Consolidated stock to the amount of £1435 in the *Maidstone Gas Company* sold at from £202 to £206 per cent. Ten £10 shares in the *Ashford Gas Company* realized £92 10s. Five £10 original ordinary 10 per cent. shares in the *Maidstone Water Company* produced £140; three lots of five £10 ordinary 7 per cent. shares, £95 each; and one lot of five £10 preference shares, £75. Messrs. King recently sold at Portsmouth, four £10 fully-paid shares in the *Portsmouth Water-Works Company* for £28 5s. each; and four £50 fully-paid shares in the *Portsea Island Gas Company*, paying 12 per cent. dividend, at £101 apiece. ——On Monday last week, 45 £10 shares and £700 of debenture stock in the *Folkestone Water Company* were sold locally by auction. The shares realized prices ranging from £237s. 6d. to £23 12s. 6d.; and the stock, from £110 to £112 10s. per cent.——Forty £5 original shares in the *Drighlington and Gildersome Gas Company* were sold on Wednesday at from £8 15s. to £8 16s. 6d.; eight £10 "A" 7 per cent. shares realized £12 13s. 6d. each; and 18 £10 "B" shares (£9 paid up) produced £11 10s. 6d. and £11 11s. 6d. apiece. It is understood that these are better prices than have been realized for similar shares in this Company for some time past.——At the Mart, Tokenhouse Yard, E.C., on the same day, Messrs. G. A. Wilkinson and Son submitted to auction 625 "A" ordinary 7 per cent. shares (£20) in the *Brighton and Hove General Gas Company*. They were divided into lots of five; and the whole of them were disposed of after some competition—the total amount realized being £18,637.

Prospective Extensions at the Halifax Corporation Gas-Works.—At the recent annual meeting of the Halifax Town Council, the Mayor (Mr. J. W. Davis), whose conduct of the affairs appertaining to his office has met with the approbation of his colleagues, was re-elected for another year. In acknowledging the honour conferred upon him, the Mayor reviewed at some length the work of the past year; and, in doing so, he made the following reference to the Gas Department: "The Gas Committee has been presided over in an admirable and trustworthy manner by Mr. Joseph Brook, with Mr. Brear as Vice-Chairman. The manufacture and distribution of gas is a very important matter. Already, the works are too small to supply the quantity required. During the winter, or in foggy weather, when there is a great demand for gas, we are almost unable to keep pace with it. Hitherto we have just kept up to it; but another foggy day would have rendered us unable to supply all the gas that was required. This matter has received careful attention, and land has been purchased during the past year, so that the whole area between Mulcture Hall on the one side parallel with the railway, to the corner of Clarke Bridge and up to the gas-works, now belongs to the Corporation; and we can extend there to a very considerable extent. I have no doubt it will be necessary during the coming year to consider plans and act upon those considerations for the erection of new works. The question of electric lighting is one that is closely connected with gas. Hitherto the Gas and the Electric Lighting Committees have worked independently. It has been suggested that it would be far better that they should join together; so that the provision of the lighting of the town shall be under one body." In connection with these remarks, it may be mentioned that in 1880, the quantity of gas made was 300 million cubic feet; while last year the output was 620 millions, and this year it is estimated that it will be 660 millions. The annual increase at present may be roughly reckoned at 5 per cent. The storeage capacity is ample for present needs, and will, in fact, be sufficient for some time to come. One holder to which has been added an outer lift is now capable of containing 2,400,000 cubic feet of gas; and is said to be the largest in Yorkshire. Altogether gas for 36 hours of the heaviest consumption can be stored. The Corporation a short time ago received the sanction of the Local Government Board to the borrowing of £100,000 for gas-works purposes.

Burgess Hill Water Company.—The accounts submitted at the half-yearly meeting of this Company yesterday week showed a balance of £828 available for distribution, which enabled a dividend of 3 per cent. to be declared for the six months.

Gas Power Locomotive Company, Limited.—A Company has been registered under the above title, with a capital of £20,000, in £1 shares, to acquire patents, inventions, machinery, &c., used in the manufacture, supply, and distribution of gas, and to develop and work them.

Lambeth Water Company.—In their report for the half year ending Sept. 30 last, the Directors recommend the full dividend on the 7½ per cent. maximum shares, and a dividend at the rate of 9½ per cent. on the remaining share capital; leaving £3312 to be carried forward.

The Lighting of Railway Carriages by Oil Gas.—The Brighton Railway Company, who were among the first to adopt electricity for lighting railway carriages, have had plant erected at their New Cross Station for the production of oil gas; and several of the trains are now lighted by means of that illuminant.

End of the Strike at the Carnegie Mills.—According to a telegram despatched from Philadelphia on the 21st inst., the Amalgamated Association of Iron and Steel Workers had officially declared the strike to be "off" at the Carnegie mills at Homestead and Beaver Falls. This decision ends all the labour troubles in those mills, to which several references have been made in our columns.

The Increase in the Price of Gas at Accrington.—The Legal and Parliamentary Committee of the Accrington Corporation have decided to take Counsel's opinion as to the liability of the Corporation to pay the increased price for the gas consumed during the past quarter. The point at issue is whether the Gas and Water Company gave notice of the advanced rate in sufficient time to entitle them to recover the higher price for the quarter ended with September.

Proposed Gas-Works Extensions at Chorley.—Last Thursday, the Chorley Town Council held a meeting at which it was decided to apply to the Local Government Board for borrowing powers for the extension of the gas-works and other local improvements. The sum required is £50,000; and among the works to be undertaken are an increase of the storeage capacity of the works, renewal of the mains and their extension to Clayton-le-Woods, and the construction of a railway siding.

The Blackburn Gas Explosion Case.—Last Tuesday, application was made to the Court of Appeal, on behalf of the Corporation of Blackburn, to extend the time for appealing against the decision of the Court casting them in damages in respect of the fatal explosion of gas in that town. It was urged that the whole Corporation should have an opportunity of pronouncing upon the advisability or otherwise of carrying the case further. Counsel for the plaintiff not objecting, an extension till the 2nd prox. was granted.

The Proposed Purchase of the Maidstone Water-Works by the Local Board.—On Aug. 17 last, the Maidstone Local Board decided, by a large majority, to apply for an Act of Parliament to empower them to purchase the undertaking of the Water Company. Since then two meetings have been held; but there were not sufficient members present on either occasion to enable the necessary resolution to be passed. This being so, it is now too late for further action to be taken in the coming session; and the matter will have to be postponed until next year.

Opposition to the Proposed Extensions at the Rochdale Gas-Works.—There is likely to be further agitation at Rochdale against the proposal of the Corporation to spend £65,000 in extending the gas-works. It will be remembered that, at the inquiry into the matter held on behalf of the Local Government Board, by Mr. Arnold Taylor, a number of property-owners appeared in opposition. Now a letter has appeared in a local paper inviting co-operation in a movement to take the opinion of the ratepayers on the subject. It is considered that the suggested expenditure is extravagant and absolutely unnecessary; and various reasons for this are given in the letter. Among others, it is mentioned that recently vast and important improvements have been made in the manufacture of gas by which such excessive expenditure or even extension of works is rendered altogether unnecessary. Then, by spending such a large sum as that proposed, it is contended that the Corporation just so far further close to the door for the introduction of the electric light, while another reason against the extension is the situation of the works.

Outside Shop Lighting at Salisbury.—About two years since the Salisbury Gas Company decided to let out regenerative lamps to their customers at a rental of 2s. 6d. per quarter; and the result has shown that, in doing so, they met a general requirement on the part of the consumers. Salisbury is a quiet cathedral town of some 16,000 inhabitants; but about 200 lamps are already in use. Nearly all the principal shopkeepers have availed themselves of the opportunity of securing an effective outside light for their windows; thus combining all the advantages of absence of vitiated air or heat that are offered by the electric light, with the reliability of gas. In the evenings the streets present a most cheerful and brilliant appearance; and the effect is considered equal to anything that can be produced by electricity. Another reason for the shopkeepers preferring the outside lighting is that it leaves the window entirely free, so that they are at liberty to arrange the goods as they please. Apart from the apparatus on hire, several of the consumers have preferred to purchase lamps for themselves. The whole have been fixed under the superintendence of Mr. N. H. Humphrys, the Assistant-Manager and Engineer to the Company, who has also designed special forms of shades, where these are necessary for directing the light upon the shop windows. The result of this enterprise is, we learn, a largely increased sale of gas. The Company have already a good business for purposes other than lighting, such as gas-engines, cooking and heating stoves, gas-fires, &c.; and the consumption of gas per head of the population in the district supplied is upwards of 5000 cubic feet per annum. Though the bulk of the lamps on hire consists of those on the regenerative principle, in some few cases other lanterns, with combinations of flat-flame burners, have been used, as more suitable to the special circumstances.

GAS AND WATER COMPANIES' STOCK AND SHARE LIST.

(For Stock Market Intelligence, see ante, p. 940.)

Issue.	Share	When ex-Dividend.	Dividend or Div. & Bonus.	NAME	Paid per Share	Closing Prices	Rise or Fall in Wk.	Yield upon investment.
£			p. c.	GAS COMPANIES.				£ s. d.
590,000	10	14 Oct.	10½	Alliance & Dublin 10 p. c.	10	16—17	..	6 3 6
100,000	10	,,	7⅞	Do. 7 p. c	10	10½—11⅛	..	6 10 5
300,000	100	1 July	5	Australian (Sydney) 5 % Deb.	100	105—107	..	4 13 4
100,000	20	27 May	8	Bahia, Limited	20	11—12	..	13 6 8
200,000	5	16 Nov.	7½	Bombay, Limited	5	6—6½	..	5 15 9
40,000	5	,,	7½	Do. New	4	4—4½*	..	6 13 4
380,000	Stck.	12 Aug.	12½	Brentford Consolidated	100	212—217	..	5 10 7
150,000	,,	,,	9½	Do. New	100	163—168	..	5 10 1
220,000	20	15 Sept.	11½	Brighton & Hove Original	20	40—42	..	5 9 6
888,500	Stck.	31 Aug.	5	Bristol	100	103—106	−1½	4 14 4
320,000	20	29 Sept	11½	British	20	40—42	−1	5 7 1
50,000	10	31 Aug.	11½	Bromley, Ordinary 10 p. c.	10	19—20	..	5 15 0
51,510	10	,,	8½	Do. 7 p. c.	10	14½—15½	..	5 9 8
328,750	10	—	—	Buenos Ayres (New) Limited	10	8—9	+⅛	—
200,000	100	1 July	6	Do. 6 p. c. Deb.	100	98—101	..	5 18 10
150,000	20	12 Aug.	8	Cagliari, Limited	20	25—27	..	5 18 6
550,000	Stck.	14 Oct.	13	Commercial, Old Stock	100	232—237	..	5 9 9
165,000	,,	,,	10	Do. New do.	100	180—185	..	5 8 1
160,762	,,	15 June	4½	Do. 4½ p. c. Deb. do.	100	123—128	..	3 10 4
800,000	Stck.	15 June	10	Continental Union, Limited	100	227—232	..	4 6 2
200,000	,,	,,	7	Do. 7 p. c. Pref.	100	190—195	..	5 2 7
75,000	Stck.	15 Sept.	10	Crystal Palace District	100	185—190	..	5 5 3
486,090	10	28 July	10	European, Limited	10	19½—20½	..	4 17 7
354,060	10	,,	10	Do. Partly paid	7½	14—15	..	5 0 0
5,470,820	Stck.	12 Aug.	12	Gaslight & Coke, A, Ordinary	100	217—222	..	5 8 1
100,000	,,	,,	4	Do. B, 4 p. c. max.	100	95—98	..	4 1 7
665,000	,,	,,	10	Do. C, D, & E, 10 p.c. Pf.	100	258—263	..	3 16 1
30,000	,,	,,	5	Do. F, 5 p. c. Prf.	100	116—121	..	4 2 7
60,000	,,	,,	7½	Do. G, 7½ p. c. do.	100	166—171	..	4 7 8
1,300,000	,,	,,	7	Do. H, 7 p. c. max.	100	161—165	−1½	4 4 9
463,000	,,	,,	10	Do. J, 10 p. c. Prf.	100	254—258	−1½	3 17 6
476,000	,,	,,	6	Do. K, 6 p. c. Prf.	100	150—154	..	3 17 11
1,061,150	,,	15 June	4	Do. 4 p. c. Deb. Stk.	100	118—121	..	3 6 1
294,850	,,	,,	4½	Do. 4½ p. c. do.	100	123—127	..	3 10 10
908,000	,,	,,	6	Do. 6 p. c. do	100	165—170	..	3 10 6
3,800,000	Stck.	16 Nov.	12	Imperial Continental	100	220—225*	..	5 6 8
75,000	5	15 June	6	Malta & Mediterranean, Ltd.	5	4—4½	..	6 13 4
560,000	100	1 Oct.	5	Met. of Melbourne, 5p. c. Deb.	100	106—108	..	4 12 7
541,920	20	16 Nov.	5	Monte Video, Limited	20	14½—15½*	+½	6 9 0
150,000	5	27 May	10	Oriental, Limited	5	8¼—8¾	..	5 14 3
60,000	5	29 Sept.	7	Ottoman, Limited	5	4—5	..	7 0 0
166,870	10	—	2	Pará Limited	10	2—3	..	—
				People's Gas of Chicago—				
420,000	100	2 Nov.	6	1st Mtg. Bds.	100	103—107	..	5 12 1
500,000	100	1 June	6	2nd Do.	100	104—106	..	5 13 2
150,000	10	—	10	San Paulo, Limited	10	8¾—9¼	..	—
500,000	Stck.	31 Aug.	15½	South Metropolitan, A Stock	100	287—292	..	5 6 2
1,350,000	,,	,,	12	Do. B do.	100	232—237	..	5 1 3
230,000	,,	,,	13	Do. C do.	100	241—246	..	5 5 8
725,000	,,	14 July	5	Do. 5 p. c. Deb. Stk.	100	140—144	..	3 9 6
60,000	Stck.	31 Aug.	11½	Tottenham & Edm'nton, "A"	100	225—230	..	5 0 0
				WATER COMPANIES.				
743,952	Stck.	1 July	10	Chelsea, Ordinary	100	247—252	..	3 19 5
1,720,252	Stck.	14 Oct.	8	East London, Ordinary	100	198—202	−1	3 19 2
544,440	,,	1 July	4½	Do. 4½ p. c. Deb. Stk.	100	140—144	..	3 2 6
700,000	50	1 July	8½	Grand Junction	50	104—109	..	3 17 11
708,000	Stck.	12 Aug.	11	Kent	100	273—278	..	3 19 1
1,043,800	100	1 July	9½	Lambeth, 10 p. c. max.	100	218—223	+1	4 5 2
406,200	100	,,	7½	Do. 7½ p. c. max.	100	190—194	..	3 17 3
285,000	Stck.	29 Sept.	4	Do. 4 p. c. Deb. Stk.	100	123—126	..	3 3 6
500,000	100	12 Aug.	12½	New River, New Shares	100	325—330	..	3 13 6
1,000,000	Stck.	28 July	4	Do. 4 p. c. Deb. Stk	100	132—135	+2	2 19 3
902,300	Stck.	15 June	6½	S'thwk & V'xhall, 10 p. c. max.	100	147—151	..	4 6 1
126,500	100	,,	6½	Do. D 7½ p. c. do.	100	135—140	..	4 12 10
1,155,066	Stck.	15 June	10	West Middlesex	100	241—246	..	4 1 3

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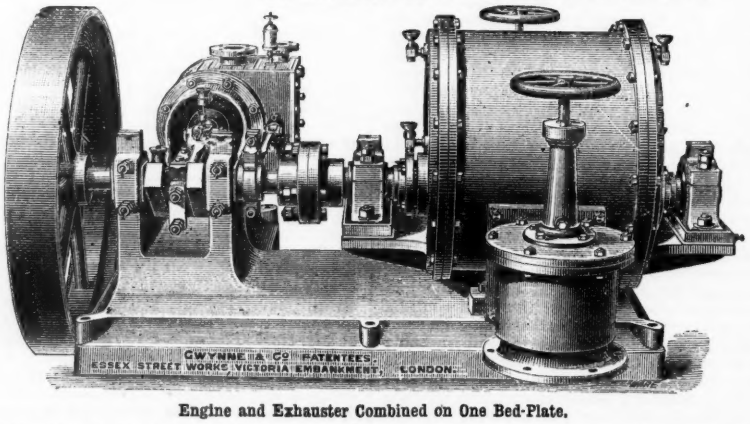

Engine and Exhauster Combined on One Bed-Plate.

GWYNNE & Co.'s Exhausters are constructed of large size to pass the required quantity of Gas at very slow speeds; the wear and tear being reduced to a Minimum.

Catalogues and Testimonials sent on Application.

Their Exhausters can be made, when desired, on their New Patent Principle, to pass Gas without the slightest oscillation or variation in pressure.

NO OTHER MAKER CAN DO THIS.

Makers of GAS-VALVES HYDRAULIC REGULATORS, VACUUM GOVERNORS, STEAM-PUMPS for Tar, Liquor, or Water; PATENT SELF SEALING AND CLEANSING RETORT-LIDS AND MOUTHPIECES; CENTRIFUGAL PUMPS and PUMPING ENGINES specially adapted for Water-Works raising Sewage, &c.

Also GIRARD and other TURBINES, HIGH-SPEED ENGINES, DYNAMOS, &c., &c., for ELECTRIC LIGHTING

NOTICE TO ADVERTISERS.—COPY FOR ADVERTISEMENTS for the "JOURNAL" should be received at the Office *not later* than TWELVE O'CLOCK NOON ON MONDAY, to ensure insertion in the following day's issue.

Orders for Alterations in, or Stoppages of PERMANENT ADVERTISEMENTS should be received not later than the FIRST POST on SATURDAY.

OXIDE OF IRON.

O'NEILL'S Oxide has a larger annual sale in the United Kingdom than all other Oxides combined. Purity and uniformity of quality guaranteed. Pamphlet, "How to Purchase Bog Ore," to be obtained on application.
Gas Purification and Chemical Company, Limited, Palmerston Buildings, Old Broad Street, London, E.C.
JOHN WM. O'NEILL, Managing Director.

GAS PURIFICATION AND CHEMICAL COMPANY, LIMITED.

ANDREW STEPHENSON, Agent.
Please address all communications to the Company, as above.

ANDREW STEPHENSON, Agent for BRIN'S OXYGEN COMPANY, Limited, Westminster, S.W.
City Address: 182, Gresham House, Old Broad Street, LONDON, E.C.

VOLCANIC Fire Cement (Winkelmann's)
Fire Resistance 4500° Fahr.
ANDREW STEPHENSON, Sole Agent, 182, Gresham House, Old Broad Street, LONDON, E.C.

CANNEL COAL, ETC.

JOHN ROMANS & SON, EDINBURGH.
Gas Engineers, supply all the most approved SCOTTISH CANNELS; also FIRE-CLAY GOODS, CAST-IRON PIPES, and other APPARATUS for GAS AND WATER WORKS.
Prices, &c., will be forwarded on application to No. 80, ST. ANDREW SQUARE, EDINBURGH, } SCOTLAND.
NEWTON GRANGE, NEAR DALKEITH, }

PORTER & CO., Gowts Bridge Works,
LINCOLN, Engineers, Ironfounders, and Contractors, for the erection of Gas-Works for Towns, Villages, Mansions, Manufactories, Collieries, and Isolated Buildings, at home and abroad. Manufacturers of Retorts and Fittings, Condensers, Scrubbers, Purifiers, Valves, &c.; also of Girders, Wrought and Cast Iron Tanks, Iron Roofs, &c.
Telegraphic Address: "PORTER, LINCOLN."

MESSRS. DEBENHAM, TEWSON, FARMER, and BRIDGEWATER'S MONTHLY LIST of Shops, Show-Rooms, Factories, and Waterside Premises, suitable for the Exhibition and Manufacture of Engineering and other Appliances, may be obtained, free of charge, at their Offices, 80, CHEAPSIDE, E.C.

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PATENTS for Inventions Secured and TRADE MARKS REGISTERED throughout the World. Advice on all matters connected with the above. Handbook gratis on application.
J. C. CHAPMAN, C.E., Chartered Patent Agent, 70, Chancery Lane, LONDON.

SITUATION wanted by a Young Man as YARDMAN, to do Fitting or Service work, or as STOKER. Good references.
Address GAS, Gas-Works, Lydd, KENT.

WANTED, by a young married Man (Abstainer), a Situation as WORKING GAS MANAGER. Used to Engine, &c. Will have to give three months' notice to leave present management.
Address No. 2153, care of Mr. King, 11, Bolt Court, FLEET STREET, E.C.

A GAS Manager, with eleven years' experience, and five years' experience in Electric Lighting, erection, and maintenance, requires re-engagement at home or abroad.
For further particulars, address No. 2159, care of Mr. King, 11, Bolt Court, FLEET STREET, E.C.

A WELL-KNOWN practical Engineer and Chemist, possessing considerable commercial experience, seeks re-engagement as REPRESENTATIVE to any good Firm, Home or Abroad. Highest references.
Address No. 2163, care of Mr. King, 11, Bolt Court, FLEET STREET, E.C.

SITUATION Wanted, by a Working Manager's Son (aged 26). Has had eight years' experience on Works making 8 million cubic feet per annum. Can do Main and Service laying, Meter fixing and repairing, and Blacksmithing.
Address No. 2158, care of Mr. King, 11, Bolt Court, FLEET STREET, E.C.

A YOUNG Gentleman (aged 26), with considerable experience of the GAS COAL and CANNEL TRADE, both Home and Export, particularly in Yorkshire and Lancashire Coals, desires an APPOINTMENT with Colliery Owners where this knowledge would be useful.
Apply, by letter, to No. 2166, care of Mr. King, 11, Bolt Court, FLEET STREET, E.C.

TEMPORARY Employment wanted by a GAS ENGINEER who is disengaged over the Winter months. Considerable experience in Gas-Works Construction, as well as in the Drawing Office. Advertiser's principal object is employment; salary being a secondary consideration.
Apply, by letter, in the first instance, to No. 2162, care of Mr. King, 11, Bolt Court, FLEET STREET, E.C.

JAMES LAWRIE & CO. supply Best SCOTCH CANNEL COALS, Best FIRE-CLAY RETORTS, BRICKS, TILES, and LUMPS; BOILER SEATING BLOCKS, FLUE COVERS, and SILICA BRICKS for SPECIAL FURNACE WORK; COKE BARROWS, BOGIES, and SMALL WAGONS.
Postal Address: 1, WHITTINGTON AVENUE, E.C.
Telegram Address: "EIRWAL LONDON."

W. C. HOLMES & Co., Huddersfield, AND 80, CANNON STREET, LONDON,
Contractors for Gas-Works complete, Makers of Gasholders, Purifiers, Scrubbers, Condensers, Retort Fittings, &c., Improved Valves, Engines, and Exhausters. Also for Collingwood's Regenerative Retort-Settings.
*** See Advertisement p. I., centre of JOURNAL.
Cablegrams: "Ignitor London." Telegrams: "Holmes Huddersfield."

J. & J. BRADDOCK, Globe Meter Works, Oldham.
First-Class Award, Melbourne Exhibition, 1889, for WET AND DRY GAS-METERS, STATION METERS, AND GOVERNORS, PRESSURE-GAUGES, STREET LAMPS AND PILLARS, &c.
Telegraphic Address: "Braddock, Oldham."

SADLER AND CO., LIMITED,
MIDDLESBROUGH; ULVERSTON (BARROW); PORTSMOUTH; CARLTON; STOCKTON; 70, Wellington Street, GLASGOW; 58, Fountain Street, MANCHESTER; and 85, Water Street, NEW YORK. Tar Distillers, Manufacturers of all TAR PRODUCTS, ALIZARINE and other TAR COLOURS, BICHROMES, OXALIC ACID, ALKALIES, LIQUOR AMMONIA, AMMONIA SULPHATE, &c.
Head Office: MIDDLESBROUGH. Correspondence invited.

WANTED, a German Gentleman with complete knowledge of English, also with considerable Engineering experience, to REPRESENT in Germany, an English firm of GASHOLDER MAKERS.
Apply, by letter, to No. 2165, care of Mr. King, 11, Bolt Court, FLEET STREET, E.C.

GAS-FITTER WANTED.

WANTED, a good reliable Workman, Compo. and Iron, with a knowledge of Meters and Service laying preferred. Permanency for a suitable man.
Apply, giving references and wages required, to the MANAGER, Gaslight Company, KIDSGROVE.

COUNTY BOROUGH OF BURNLEY.

THE Gas Committee of the Corporation of Burnley require the services of an ANALYTICAL CHEMIST at their Gas-Works.
Salary, £80 per annum to commence with.
Applications, stating age, qualifications, and references, to be sent to the undersigned.
JNO. P. LEATHER.
Gas-Works, Burnley,
Nov. 25, 1892.

VENTNOR GAS AND WATER COMPANY.

WANTED, an experienced Plumber as a WASTE-WATER INSPECTOR, and to do Plumbing and Gas-Fitting as required. One holding a Certificate will be preferred.
Candidates to make application (in their own handwriting) to the Secretary, at the Company's Offices, Victoria Street, Ventnor, on or before the 15th day of December next, stating age, wages required, where last employed, and enclosing testimonials.
By order,
J. S. INESON,
Secretary.
Ventnor, Isle of Wight,
Nov. 24, 1892.

SMALL GAS-WORKS.

WANTED, to Lease or Purchase, a SMALL GAS-WORKS, in actual work.
State particulars as to present consumption of Gas, Price required, &c., to No. 2164, care of Mr. King, 11, Bolt Court, FLEET STREET, E.C.

WANTED, Offers of Muriate of Ammonia (crude and refined), and all other Ammonia and Tar Products.
RINAU-KESSEL AND CO., Cologne, GERMANY.

IN consequence of Extensions, the Ramsgate Corporation Gas Department have the following VALVES FOR SALE:—
Eleven 14-inch, C. and W. Walker's make,
One 12-inch, Owen and Mann's make,
Three 12-inch, Burton, Sons, and Waller's make.
All in fair condition.
Offers to be sent in at once, addressed to the Chairman of the Gas and Water Accounts Committee, endorsed "Valves."

CAST-IRON TANK AND GASHOLDER FOR SALE.

THE Chelmsford Gaslight and Coke Company have for immediate disposal a CAST-IRON TANK, 32 ft. diameter by 17 ft. 6 in. deep, and a GASHOLDER, 30 ft. diameter, complete with columns (five in number), Guides, Pulleys, Inlet and Outlet Pipes, Valves, &c.
Any further information to be had of the undersigned on application.
E. G. SMITHARD,
Engineer.
Gas-Works, Chelmsford,
Nov. 11, 1892.

IRISH BOG ORE OXIDE OF IRON.

GAS PURIFICATION.

BALE, BAKER, & CO., direct Importers from Ireland. Sample and Price on application.
OXIDE PAINT, SULPHURIC ACID, & Chemicals.
120 and 121, NEWGATE STREET, LONDON, E.C.

OXIDE OF IRON.

FINEST Quality of Natural Bog Ore
Particulars and price, apply to Mr. T. L. ARCHER, Cathedral Chambers, Half Street, MANCHESTER.

SULPHURIC ACID.

JOHN NICHOLSON & SONS, Chemical Works, LEEDS, specially produce this ACID from BRIMSTONE, for making SULPHATE OF AMMONIA of high quality and *good* colour. Delivery in our own Railway Tank-Wagons or Carboys. Highest references and all particulars supplied on application.

OXIDE OF IRON. Genuine Natural Bog ORE. QUALITY AND CONDITION GUARANTEED. Any quantity supplied at lowest rates.
D. M. NELSON AND SONS, 68, Bath Street, GLASGOW. Telegraphic Address: "Gas, Glasgow." Depôts throughout England and Scotland.

LIQUOR and Tar wanted.
BROTHERTON AND CO., Ammonia and Tar Distillers, LEEDS and WAKEFIELD.

FRIEDRICH LUX, Ludwigshafen am Rhein; and at No. 142, Great Portland Street, London, W.
LUX'S Gas Regulators for every consumption.
LUX'S single-stem Pressure-Gauges.
LUX'S Regulator for Gas-Engines.
LUX'S Gas-Balance.
LUX'S new Gas Regulator for Inverted Lamps and other Apparatus for Gas Lighting, &c.

THE LARGEST GASHOLDER IN THE WORLD.

THREE whole-plate Photographs—viz., when full of Air on the 14th inst., Interior of Tank, and Columns alone—of the new Gasholder at East Greenwich. Price 2/- each (cash with order).
J. S. HAZARD, 11, King William Street, GREENWICH

FOR SALE—A perfectly new 20,000 cubic feet per hour EXHAUSTER, with Steam-Engine combined, including Hydraulic Gas Governor, Bye-Pass Valves, and Connections.
For further particulars, apply to Mr. T. G. MARSH, 41, Corporation Street, MANCHESTER.

SULPHATE OF AMMONIA.

THE Merthyr Tydfil Gas Company are prepared to consider OFFERS for the purchase of about 12 tons more or less of SULPHATE OF AMMONIA
The highest or any offer not necessarily accepted.
Offers must be received not later than the 6th prox., and must be endorsed "Sulphate," and addressed to E. B. Evans, Esq., J.P., Chairman of the Committee of Directors.
Samples and particulars will be supplied on application.
JOHN L. COCKER,
Manager and Secretary.
Gas Offices: Gas-Works, Merthyr Tydfil,
Glamorganshire, Nov. 18, 1892.

CORPORATION OF LEICESTER.

RETORTS AND FIRE-BRICKS.

THE Gas Committee of the above Cor- poration are prepared to receive TENDERS for the supply and delivery of RETORTS and FIRE-BRICKS.
Specification, Quantities, and Form of Tender, can be obtained from the Engineer.
Tenders, addressed to Alderman Lennard, Chairman, and endorsed "Tender for Retorts, &c.," to be delivered at these Offices not later than Eleven o'clock a.m. on Saturday, Dec. 10, 1892.
The Committee do not bind themselves to accept the lowest or any tender.
ALFRED COLSON, M.Inst.C.E.,
Engineer and Manager.
Gas Offices, Millstone Lane,
Leicester, Nov. 18, 1892.

SHEFFIELD UNITED GASLIGHT COMPANY.
NEEPSEND AND ARUNDEL STREET STATIONS.

TO GASHOLDER MAKERS.

THE Directors of this Company invite TENDERS for the repair and re-sheeting of the Two OUTER LIFTS of a GASHOLDER at each of the above Stations. The Gasholder at Neepsend is 151 ft. diameter by 30 ft. deep, and at Arundel Street 110 ft. diameter by 24 ft. deep.
Forms of Tender, with Bill of Quantities, may be obtained, and the Specification seen, on application to the Engineer, Mr. Fletcher W. Stevenson, at the Company's Offices, Commercial Street.
The Directors do not bind themselves to accept the lowest or any tender.
Sealed tenders, marked "Tender for Repairing Gasholders," and addressed to the undersigned, must be delivered at the Company's Offices by post, not later than Saturday, the 3rd day of December next.
HANBURY THOMAS,
General Manager.
Commercial Street, Sheffield,
Nov. 12, 1892.

THE NEWLY-PATENTED BOWER REGENERATIVE GAS-LAMP.

VERY many thousands of Lamps under the old Patents sold, and four Gold Medals and other Prizes have been awarded to them in open competition; but the NEW LAMP *gives a much better light than the old one*, and is cheaper and more durable.
Particulars of GEORGE BOWER, St. Neots, HUNTS.

COUNTY BOROUGH OF STOCKPORT.
(GAS DEPARTMENT.)

TO IRONFOUNDERS, ETC.

THE Gas Committee are prepared to receive TENDERS for the supply of about 1000 yards each of 3-inch and 4-inch diameter CAST-IRON MAINS. Weight per yard not to exceed 84 lbs. and 46 lbs. respectively. Also IRREGULARS of both sizes.
Tenders, endorsed "Mains," and addressed to the Chairman of the Gas Committee, Gas-Works, Stockport, to be sent in on or before the 7th day of December, 1892.
The Resolution of the Council that Contractors will be expected to pay the average rate of wages paid in he district will apply to this Contract.
Forms of Tender and any further Information may be obtained on application to the Engineer, Mr. S. Meunier, Stockport.
The Committee do not bind themselves to accept the lowest or any tender.

By order,
WALTER HYDE,
Town Clerk.

Nov. 25, 1892.

EAST LONDON WATER-WORKS COMPANY.

ISSUE OF NEW CAPITAL.

NOTICE is hereby given, that the Di- rectors are prepared to receive TENDERS for £25,000, being the fifth portion of the New Perpetual Debenture Stock of the Company, to bear Interest at 4½ per cent. per annum, free of Income-Tax, such tenders to be delivered at the Company's Offices, St. Helen's Place, in the City of London, not later than Twelve o'clock Noon, on the 15th day of December, 1892, and payment of accepted tenders made on the 23rd of December.
Particulars and Conditions, together with Form of Tender, may be obtained at the said Offices, or will be forwarded on application.

By order of the Court of Directors,
ISAAC ADOLPHUS CROOKENDEN,
Secretary.

St. Helen's Place, London,
Nov. 5, 1892.

SOUTH METROPOLITAN GAS COMPANY.

£25,000 Five per Cent. Perpetual Debenture Stock of the above Company, presenting an Investment of the soundest description.

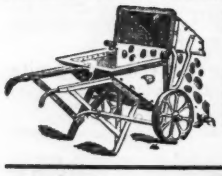
MESSRS. G. A. WILKINSON and SON are instructed by the Directors to SELL by AUCTION, at the Mart, on Friday, Dec. 9, at Two o'clock precisely, in numerous lots, to suit large and small purchasers, £25,000 of FIVE PER CENT. PERPETUAL DEBENTURE STOCK of the South Metropolitan Gas Company.
The districts supplied by the Company comprise nearly the whole of the South of London, from Wandsworth to Plumstead Marshes; and the demand has so much increased that the supply of Gas has been nearly doubled within the last Ten Years.
Particulars may be had of FRANK BUSH, Esq., Secretary of the Company, 709A, OLD KENT ROAD; of Messrs. BUDD, JOHNSONS, AND JECKS, Solicitors, 24, AUSTIN FRIARS; and of Messrs. G. A. WILKINSON AND SON, Surveyors and Auctioneers, 7, Poultry, CITY.

NOW READY.
GAS AND WATER CO.'S DIRECTORY, 1892.
Sixteenth Annual Issue, 5s.
GAS-WORKS STATISTICS, 1892.
Fourteenth Annual Issue, 3s. 6d.
WATER-WORKS STATISTICS, 1892.
Twelfth Annual Issue, 2s. 6d.
Handsomely Bound in One Vol., Price 10s.

LONDON: HAZELL, WATSON, & VINEY, Ltd.,
1, CREED LANE, E.C.

ALEXANDER RUSSELL & CO.,
Cannel and Gas Coal Merchants,
53, WATERLOO STREET,
GLASGOW.

PRICE'S PATENT COKE & COAL BARROW



effecting a great saving of time labour, and expense.
For particulars, price, &c., apply to Mr. E. PRICE, Inventor and Patentee, 22, Alwyne Road, Canonbury, LONDON, N.

Prices are Reduced.

AUG. KLÖNNE,
DORTMUND (GERMANY).

REGENERATIVE FURNACES.

Unsurpassed in
Efficiency, Economy, Durability, and Easy Working.

MEIKLEJOHN'S PATENT
Improved Slide-Valve Anti-Dip.

Is perfectly reliable in action, and requires no attention. Has all the advantages of the Dip and Anti-Dip combined.
Is cheap and easily fixed to any form of main.
Will be found the most efficient appliance of the kind yet introduced.
Further particulars and price from

C. MEIKLEJOHN,
GAS-WORKS, RUGBY.
(Late N. MEIKLEJOHN, Longwood.)

UNEQUALLED.

Gas Companies are solicited to try Samples of the

MIRFIELD
BLACK BED GAS COAL.

Prices and Analysis on application.

MIRFIELD (GAS-COAL) COLLIERY COMPY.
RAVENSTHORPE, NEAR DEWSBURY.

JAMES OAKES & Co.,
ALFRETON IRON-WORKS, DERBYSHIRE,
AND
Wenlock Iron Wharf, 21 & 22, Wharf Road,
CITY ROAD, LONDON, N.

Manufacture and keep in Stock at their Works (also large stock in London)
PIPES and CONNECTIONS, 1½ to 48 inches in diameter, and make and erect to order RETORTS, PURIFIERS and TANKS, with or without planed joints, COLUMNS, GIRDERS, SPECIAL CASTINGS, &c., required by Gas Water, Railway, Telegraph Chemical, Colliery, and other Companies.
NOTE.—Makers of HORSLEY'S PATENT SYPHONS. These are cast in one piece, without Chaplets; doing away with bolts, nuts, and covers, and rendering leakage impossible.

THOMAS TURTON
AND SONS, LIMITED,
Sheaf & Spring Works,
SHEFFIELD,
MANUFACTURERS OF
FILES OF BEST QUALITY
FOR ENGINEERS.
STEEL OF ALL DESCRIPTIONS.
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JAMES WHITE & CO., LTD.,
WIDNES, LANCASHIRE,
Manufacturers of Special
FIRE-BRICKS,
FIRE-CLAY, &
FURNACE CEMENT.

FOR GAS FURNACES our GANNISTER and SILICA FIRE-BRICKS are acknowledged to be the best and most durable in the Market.

GANNISTER and SILICA FIRE-CLAY guaranteed the Purest Quality.

FURNACE CEMENT specially made for repairing Furnaces and stopping Cracks.

ANALYSIS AND REFERENCES ON APPLICATION.

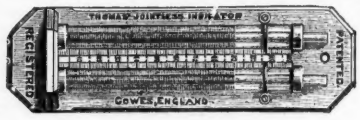
HOLMSIDE GAS COALS.
(Wrought out of Holmside and South Moor Collieries.)

PRESENT production over 3200 tons per working day. Area of coal about 5000 acres, including the largest remaining workable proportion of pure HUTTON SEAM GAS COAL. Analysis of HOLMSIDE GAS COAL *in bulk as shipped* gives 10,500 cubic feet of Gas per ton, of an Illuminating Power of 16½ candles. The Sulphur is about 1 per cent., and the Ash 1¾ per cent. The Coal cokes well, and leaves about 70 per cent. of excellent Coke. To show the progress of HOLMSIDE COALS, it may be mentioned that the quantity carbonized by the London Gas Companies in 1885 was about 200,000 tons; whereas the present consumption of HOLMSIDE COALS in London alone is at the rate of over
400,000 Tons per Annum.

Full particulars on application to
MR. MARK ARCHER,
HOLMSIDE AND SOUTH MOOR OFFICES,
NEWCASTLE-ON-TYNE.

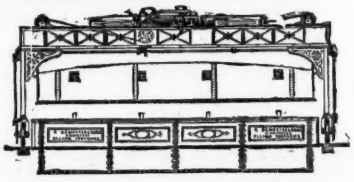
ROBERT MARSHALL,
CANNEL COAL MERCHANT,
97, WELLINGTON STREET, GLASGOW.

Prices and Analysis of all the Scotch Cannels on application



THOMAS'S JOINTLESS GAS GAUGES.
COWES, I.W.
American Patent for Sale.

DEMPSTERS'



PURIFIERS (MACHINED JOINTS)
PURIFIERS.
ELLAND.

T. B. KITTEL, SHEFFIELD.
CONTRACTS FOR SUPPLIES OF ANY OF THE PRINCIPAL
ENGLISH & SCOTCH CANNELS.
REAL SILKSTONE GAS COAL
ANALYSIS AND PRICES ON APPLICATION.
T. B. KITTEL, SHEFFIELD.

THOMAS ILLINGWORTH,

NORTH DEAN CHEMICAL WORKS,
Near **HALIFAX,**
MANUFACTURER OF SULPHURIC ACID
OF EXTRA QUALITY FOR MAKING
WHITE SULPHATE OF AMMONIA.

TAR, LIQUOR, AND SPENT OXIDE
Purchased for Cash against Delivery.

BOLDON GAS COALS.

Worked by THE HARTON COAL CO., LTD.,

Output about 3000 tons per day.

ANALYSIS—

Yield of Gas per ton . .	10,500	Cubic Feet.
Illuminating Power . .	16·9	Candles.
Coke	66·7	Coke.
Sulphur	0·86	Sulphur.
Ash	2·04	Ash.

Boldon Gas Coals are supplied under contract to

The Gaslight and Coke Company, South Metropolitan Gas Company, Imperial Continental Gas Association, European Gas Company, L'Union des Gaz (the Continental Union Gas Company), Danish Gas Company of London, Ipswich Gaslight Company, Devonport Gas Company, Newcastle Gas Company, Sunderland Gas Company, South Shields Gas Company, and to many other Companies at Home and Abroad.

For prices, &c., apply to the

HARTON COAL COMPANY,
LIMITED,
Newcastle-on-Tyne.
W. H. PARKINSON,
FITTER.

NEWBATTLE CANNEL.

Highest Results in Gas, & Excellent Coke.

QUOTATIONS ON APPLICATION TO

THE LOTHIAN COAL COMPANY,
LIMITED,
NEWBATTLE COLLIERIES,
DALKEITH, N.B.

CAST-IRON PIPES

FOR GAS AND WATER.

Pipes, One to Six inch Bore, kept in Stock. Also a very large assortment of all sizes of Bends, T-pieces, and Specials ready for despatch on receipt of Order.

VALVES

FOR GAS, WATER, AND STEAM.

TELEGRAMS: "PIPES GLASGOW."

WM. MACLEOD & CO.,
56, ROBERTSON STREET, GLASGOW.

THE SILICA FIRE-BRICK

COMPANY,
OUGHTIBRIDGE, near SHEFFIELD,
MANUFACTURE

SILICA BLOCKS, BRICKS, AND CEMENT

OF SUPERIOR QUALITY
FOR GAS-FURNACES.

Trade Mark: "SILICA."

These Goods (largely used in Gas, Glass, Iron, and Steel Works) are, on account of their

GREATER DURABILITY,

Strongly recommended where EXCESSIVE HEATS have to be maintained.

TROTTER, HAINES, & CORBETT,

Brettell's Estate
FIRE-CLAY & BRICK WORKS,
STOURBRIDGE.

Manufacturers of GAS-RETORTS, GLASSHOUSE FURNACE & BLAST-FURNACE BRICKS, LUMPS, TILES, and every description of FIRE-BRICKS.
Proprietors of
BEST GLASSHOUSE POT & CRUCIBLE CLAY.
SHIPMENTS PROMPTLY AND CAREFULLY EXECUTED.

Awarded HIGHEST MEDAL and DIPLOMA at the Newcastle-on-Tyne Royal Mining and Industrial Exhibition, 1887, for

CANNEL & COAL.

TYNE

BOGHEAD CANNEL.

Yield of Gas per ton	13,155 cub. ft.
Illuminating Power	38·22 candles.
Coke per ton	1,301·88 lbs.

EAST PONTOP GAS COAL.

Yield of Gas per ton	10,500 cub. ft.
Illuminating Power	16·3 candles.
Coke	70 per cent.

For Prices and complete Analysis, apply to

YOUNG, DANCE, & CO.
COAL OWNERS, NEWCASTLE-ON-TYNE.
Or E. FOSTER & CO., 21, John St., Adelphi, LONDON, W.C.

GAS COAL.

BEST
REAL OLD SILKSTONE GAS COAL,
Address **THE STRAFFORD COLLIERIES COMPANY,**
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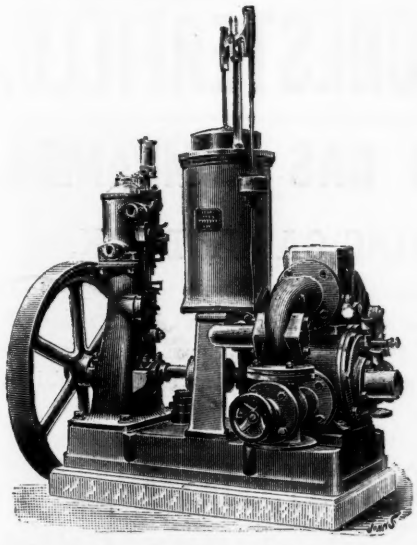

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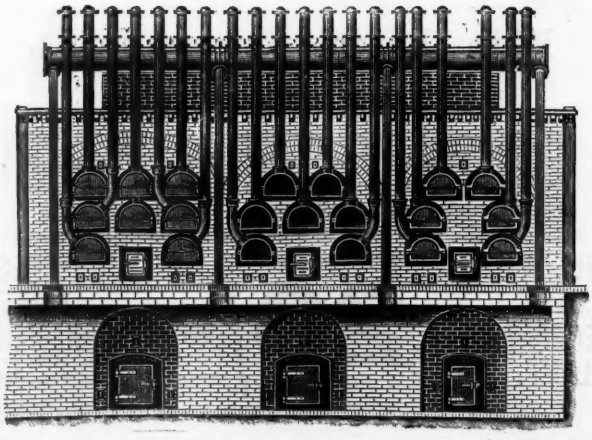

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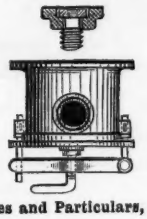

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(COPY OF A LETTER RECEIVED)

From THE FORMBY GAS COMPANY, LIMITED, FORMBY, Nov. 11, 1892.

To **Messrs. R. & J. DEMPSTER,** MANCHESTER.

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You will be pleased to learn that it continues to work satisfactorily; the holder rising and falling freely, yet without any oscillation. Here we are situated on the coast, and exposed to the full force of the gales from the Irish Sea; but they have not the slightest effect upon the holder.

Yours truly,
J. W. BUCKLEY.

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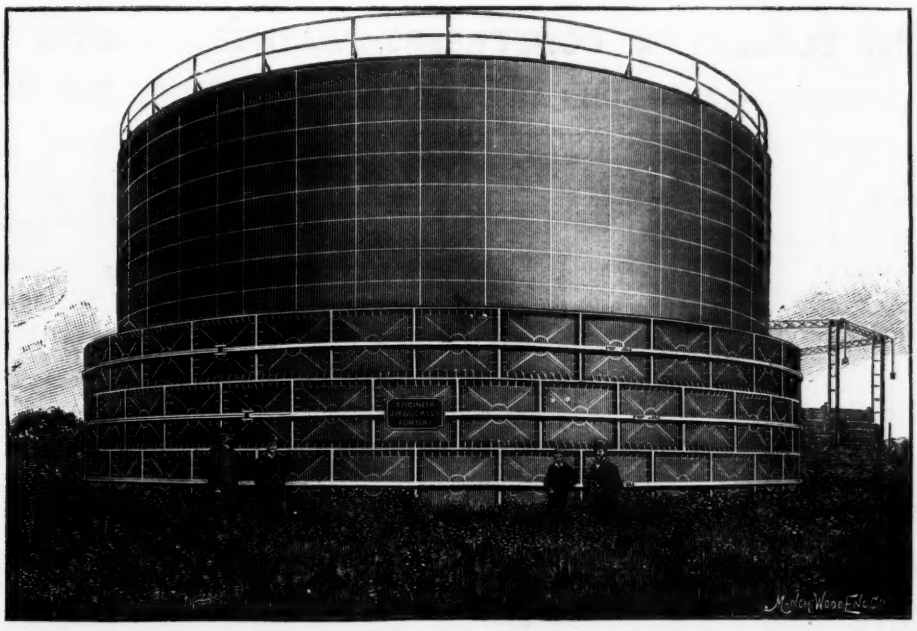

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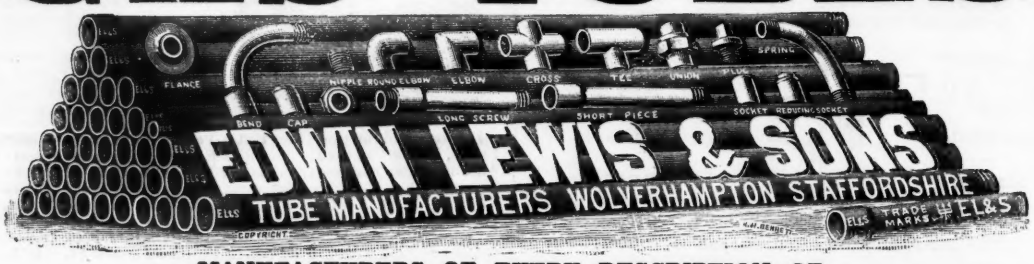

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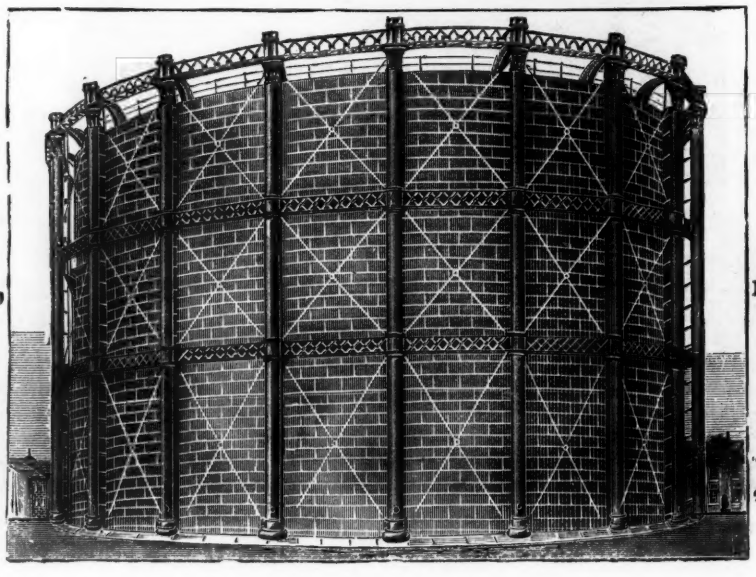

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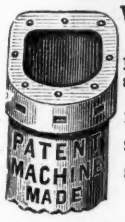

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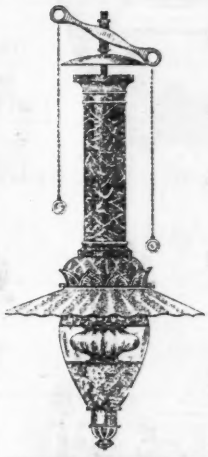

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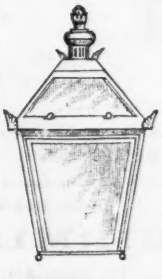

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[See also Advt., p. 936.

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